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AUTOMOBILE INTRODUCTION IN THE WEST.

An automobile exhibition like the one recently held at Chicago, which brings together prospective agents and customers from over a large territory in which the centers of population are widely scattered, as compared with the East, impresses those interested in the growth and prosperity of the electric vehicle business with the importance of securing at numerous central points where agencies are located, arrangements for not only charging, but inspecting, overhauling and repairing vehicles. While the electric vehicle requires usually no expert attention when on the road—which fact gives it a well recognized commercial advantage over other forms of motive power—it does require to be brought under the eye of an expert in the shop; and such attention should be given it at frequent intervals if satisfactory service is to be obtained from the vehicle. The manuafcturer or agent who loses sight of this fact is doomed to go through a great deal of costly and damaging experience in the introduction of the electric vehicle. There is no piece of electrical apparatus more likely to be damaged by neglect than the automobile battery, and satisfactory battery service is at the heart of the electric automobile business.

This fact might as well be recognized first as last. In starting agencies in various cities of the West there will be a strong temptation on the part of agents to leave out the repair and maintenance feature, but the business will suffer severely in the end if this is done. In connection with repair and maintenance comes the question also of charging facilities, which need to be well looked after before attempting to sell vehicles. In many cases through the West, where cities cover larger areas in proportion to population than in the East, and consequently where 110-volt direct current systems are not so frequently available for charging, it usually settles down to a question of either putting in a motor generator to run from a 500-volt or alternating circuit, or putting in a gas engine and dynamo.

There are two classes of business men seeking automobile agencies in the West. One class consists of local carriage dealers, who have an established trade among carriage buyers, and are naturally the ones to whom carriage buyers would go for electric vehicles, could they get them. The other class consists of local electrical supply and construction houses which have no acquaintance with the carriage buying world, but have more intelligent ideas than the carriage agencies as to the practical requirements of the business. A combination of these forces would seem to be of advantage, and will probably be worked out in some way.

ELECTRICITY IN AUTOMOBILISM.

The intensely interesting report of Mr. Fliess, which we are now publishing, deals essentially with the electrical side of the great automobile problems, but has its value for all engaged in the field of mechanical traction, no matter which motive power they may favor. The improvements that his data suggests are in reality, common to all classes of vehicles; while the betterment of streets and roads, upon which much of the future success of the automobile depends, is a matter of universal interest and importance.

We believe that in promoting the cause of good roads rather than by indulgence in fantastic racing, the Automobile Club of America will find its true mission and win that influence at which it aims in national automobile affairs. There is no harm in standardizing the

rules of racing, but it is vastly more vital to enable automobiles to get from one part of the country to another and to circulate safely around any given city. We should like to see the Club's good roads programme insisted on vigorously for one thing in the new year, and it would not be amiss also if electrics were more considered in the make-up of its management. We know that among some members there is a feeling that so far as there is any tendency of the kind, steam and hydro-carbon interests have been allowed to overshadow others. Such a club should be carried on free of cliques and interests, broadly fair to all, developing the social side, and seeking to promote ends that touch the largest welfare of the community.

Paris Awards.

Comment on one aspect of the curious awards made at the Paris Exposition appeared in these columns recently. Another point deserves note now, namely, the attempt to convince the American public that the United States fared very well at the hands of the juries. A special dispatch from Paris, emanating probably from Commissioner Peck, says that the Jury of Final Appeal in the Exposition awards had finished its work and that the statement prepared for the United States Commission showed that the United States received a higher total of awards than any other nation, save France, and that she also received more awards in each classification, except grand prizes, in which Germany secured a greater number. This misleading statement is repeated by Mr. Louis Stern, one of the New York State Commissioners, in an interview last week, when he said: "American exhibitors have every reason to feel satisfied with the recognition they received. I believe that next to France they received the highest number of medals and awards."

Both of these statements omit the fact that, next to France, the United States had the largest number of exhibitors, but that in spite of such a preponderance her proportion of awards brought her far down the list. Mr. Stern has been imposed upon by somebody if he has been led to believe that that is creditable to this country or its Commission. For example, in machinery, the United States stands at the very foot of the list in grand prizes and gold medals per number of entries. The same is true, unfortunately, in electricity, with an even worse average; and it is twice as bad again in mining and metallurgy. Even in agriculture, the United States makes a poorer showing than any other country!

The only inference can be that neither our Commissioners nor our jurors were successful in protecting the interests that had been confided to them. In electricity, Austria, with 25 entries, had 5 grand prizes and 17 gold medals. The United States, with 283 entries, had 6 grand prizes and 23 gold medals. In machinery, Switzerland, with 14 entries, got 9 grand prizes and 15 gold medals. The United States, with 282 entries, got a paltry 10 grand prizes and 26 gold medals. The relative proportions are preposterous. We refuse to believe that American machinery, now sweeping Europe, is inferior to the Swiss or Austrian in any such degree as this implies. We beg to inform Commissioner Peck and Mr. Stern that American exhibitors cannot "feel satisfied with the recognition they received" under such circumstances.

So Near and Yet so Far.

Lives there the electrician who can watch a firefly without a trifling but persistent sense of annoyance? The little bug winks maliciously in the possession of his secret, until the electrician goes home and turns on his 5-per-cent-efficiency incandescent lamp to kick himself by. Years ago a merchant in the town of our boyhood failed ignobly and paid his enraged creditors five cents on the dollar. They nursed their wrath in silence until the next Fourth of July, and then in the annual procession of Antiques and Horribles sent forth a platoon of tatterdemalion sandwich men bearing the legend, "We Pay Five Cents on the Dollar." And that jibe insistently comes back to us whenever we fall to contemplating an incandescent lamp. For the past ten years the subject of luminescent lamps has been occupying the attention of a considerable group of experimenters, and the whole matter has been persistently "in the air," but as yet no material results are at hand. The early work upon this line was certainly most striking and promising, but the promises have so far been like those of our whilom townsman, and, now, with the twentieth century close at hand, the end seems as far removed as it did a decade ago.

It is not altogether flattering to human ingenuity that so important a problem should remain unsolved. It is a most tempting field for inventors, for a successful luminescent lamp would be simply revolutionary in its results. There is good reason to believe that an efficiency of one-quarter to one-half watt per candle-power is well within the bounds of possibility, and if such efficiency were attained by any reasonably simple means, the incandescent lamp would be most assuredly doomed to join the whale-oil lamp in the scrap heap of oblivion. But the time is not yet, however near at hand it may prove to be. The experiments thus far made have been along two distinct lines—the luminescence of gas, and the excitation of certain luminescent solids by the electric discharge. The familiar Geissler tube is a type of the first method, and some forms of Crookes' tubes of the second. No one who has worked with the little Geissler tubes of the laboratory has failed to be impressed with their apparently high light-giving power, obtained evidently by a very small expenditure of energy. Their apparent failings are the need of rather high voltage and small intrinsic brilliancy. The first mentioned difficulty is rather annoying, but if it were the only one it is quite certain in the present state of our knowledge of the electrical discharge in gases, that it would be very promptly overcome. The second is more formidable. Low intrinsic brilliancy is in itself quite unobjectionable, since total quantity of light is the thing sought, but if the brilliancy is small, the luminescent surface must be greatly increased, so that the bulk and cost of the lamps would rise, enough perhaps to offset any gain in efficiency. Luminescent solids seem to give a far brighter light without the use of more voltage in the exciting current than in the case of Geissler tubes, but their permanency remains yet to be proved, and is somewhat open to question.

In both classes of experiments the color of the light is a matter which requires serious attention. In most cases there is a ghastly greenish or bluish tinge to the light that would be commercially forbidding, but there are substances, perhaps not the best in other respects, which give luminescence of a suitable hue; and while the color question will require very thorough experimenting, it raises no forbidding difficulty. Once a bright and efficient luminescent lamp is produced, minor troubles like this will be soon disposed of.

The practical conditions of the problem may easily be set forth. For commercial success a luminescent lamp must be steady and of good color, white or yellowish white. It must have fairly good intrinsic brilliancy, very much better than ordinary Geissler tubes, say in the vicinity of one or two candle-power *per square inch*. Less brilliancy than this requires apparatus altogether too bulky. As to the total amount of light per lamp, it is not necessary to go above present incandescent practice, and subdivision to five or ten candle-power per unit would be rather an advantage for many purposes, although a lamp which could readily be given several times this power, if necessary, would be preferable to one practically confined to a few candle-power. As to life, a great gain in efficiency would be

worth making some sacrifice of life, but unless the effective life reaches several hundred hours, the trouble of replacement would militate against the commercial pre-eminence of the lamp. If the lamp should fail by growing dim, the case is worse than if it should hold a good brilliancy for even a couple of hundred hours and then fail suddenly. Such lamps should be able to be worked at a voltage of not more than 100 to 200, it matters little whether alternating or direct, provided no unusual frequency is required in the former case. Even lamps requiring tiny individual or group transformers would not be unworkable if of very great efficiency, but those operable off regular mains would be preferable. As to efficiency, if the problem is solved at all as regards good and steady light, little need be feared. At even a watt per candle a luminescent lamp could capture the art, and half this or less seems fairly probable. The greatest difficulty will prove to be the production of a steady light of uniform brilliancy under commercial working conditions, irrespective of the heating which must be reckoned with even at a very high luminous efficiency. The more nearly monochromatic the light the better the probable efficiency, but the greater the color difficulties.

The Rating of Incandescent Lamps.

In another column we print an abstract of a paper by Prof. A. J. Rowland on "Mistakes in the Rating of Incandescent Lamps." Prof. Rowland very properly draws attention to the difference between the horizontal and vertical luminous intensity or candle-power of an ordinary incandescent lamp. He says that a 16-cp lamp may be only a 5-cp lamp when viewed end on, while the best lamp he measured had a tip intensity of only 10 candles. He argues that since most incandescent lamps are supported vertically, so as to throw their light downward through the tip, the tip intensity should be the controlling and commercial basis of comparison. In other words, the existing 16-cp lamps of commerce should be rated according to their tip intensities—ordinarily between 5 and 10-candle lamps.

There is much force in this argument, but we think that it is overstated. It is no doubt true that we overestimate the useful illuminating power of a lamp when we accept its present commercial rating, for the reason that an ideal 16-cp lamp would be not only a 16-mean-spherical-candle-power lamp, but should also, like a point source, emit an intensity of 16 candles in every direction; whereas, the intensity does actually vary from perhaps 7 to 20 candles, the former usually near the tip, and the latter usually near the equator. On the other hand, however, the tip is but a tip in surface, while the equator is a long band, and to rate a lamp at its lowest valuation from a little beam at the tip, ignoring the long equatorial band of greater intensity is, we think, to go to the other extreme. Justice lies somewhere between these two opposite contentions.

If there were no reflection of the light emitted by an incandescent lamp, and if all lamps were supported with their tips immediately over small surfaces to be illumined, then Prof. Rowland's proposed amended rating would undoubtedly be correct. On the other hand, the higher the reflecting power of surrounding objects, the lesser the importance of the tip intensity, and the greater the importance of the mean horizontal and of the mean spherical candle-power. Of the five different types of lamps and lamp filaments tested, all nominally 16-cp lamps, the mean horizontal candle-power was 16.2 candles, with a maximum deviation of 4 per cent, and the mean spherical candle-power 13.5 candles, with a deviation of 6 per cent, so that the total light-giving power, or flux of light, given by these lamps was nearly the same for all, although one had a tip candle-power of 4.8, and another of 10.1 candles. It is pointed out in the paper that, even allowing for the fact that lamps have equal mean spherical intensity, if the bulk of the light is thrown off in directions where it cannot be utilized, and only a small zone of luminous rays issuing at and around the tip can be utilized, then the tip measurement is the only useful one.

This is an argument for the use of reflectors or refractors as much as for a change in rating. Now, admitting for the sake of argument that the walls and ceilings of a room are so dull in color and character as to reflect too little of the light incident upon them, yet it must be remembered that most incandescent lamps are set in shades of porcelain or white glass, which throw back a large proportion of the light cast into regions out of the directly serviceable zone. Consequently, in practice, we have to deal not merely with the incandescent lamp, but with an incandescent lamp encircled with its shade, and the results obtained and set forth in the paper require considerable modification, in view of this circumstance. With holophane globes the same deviation occurs to even a more marked extent. In other words, the better the diffusing and reflecting power of the shade or globe surrounding an incandescent lamp, the greater the importance of the mean horizontal candle-power and the less the importance of the tip candle-power, the mean spherical candle-power being, of course, more important still, although not commercially employed.

The practical objection to tip measurements of candle-power, apart from the manufacturer's objection, is, of course, the same as the objection to single-reading stationary-lamp horizontal candle-power measurements, as compared with revolving-lamp mean horizontal candle-power measurements; that is to say, the cone of rays from the tip of the lamp which is utilized in making the measurement is about one hundred times smaller in area than the cone utilized in mean horizontal measurements, with a correspondingly reduced liability to accidental variations.

We notice in certain recent specifications for incandescent lamps a clause virtually specifying that the tip intensity shall not be less than 44 per cent of the mean horizontal intensity. This is perhaps the fairest method of rating. If lamps were sold on their tip candle-power, this would be placing a premium not merely upon tipless globes, but also upon any artifice which would serve to reflect more light out at the tip and less out at the equator, even though a globe or reflector outside the lamp might be capable of utilizing the equatorial rays. This would be quite unfair. There is one, and only one, true criterion of the illuminating value of an incandescent lamp when the special circumstances of its use and installation are not given, and that is the total quantity of light which it emits at its rated voltage. This total quantity of light is expressible in terms of its mean spherical candle-power or the candle-power as averaged over all the surface of the globe. Now, it is regarded as commercially impracticable to measure the light all over the surface, so the next best thing is to measure the light over some band or great circle around the globe, usually the equatorial circle, and in the absence of spherical measurements such great circle measurements should be adopted as the best and faiest method of comparison, with a reservation clause, perhaps, as to the minimum which should be allowed in the most ill-favored directions.

The plea which the paper makes for a tipless lamp is admissible. There is no real necessity for a tip or nipple upon the bulb. It is not an ornament, it is an obstruction to light, and is usually in the path of the most important and useful beams of the lamp. The paper is well worthy of consideration, if only in calling attention to the importance of getting rid of tips. Moreover, with no tips to the lamps, there would also be no ratings based solely on tip measurements, whether the lamps are tipped or tipless.

The Hudson Funeral Exercises.

About one hundred and fifty friends and business associates honored the memory of John E. Hudson, president of the American Bell Telephone Company, by attendance at his funeral at noon on Oct. 3 at his summer residence, Beverly, Mass. The Rev. James De Normandie, of Roxbury, conducted the services and paid a warm tribute to a friend of thirty years' standing. The Trinity Church Quartet from Boston sang two hymns. More than a hundred people went down to Beverly on a special train. Among these were all the officers of the American Bell Telephone Company and the American Telephone & Telegraph Company, and prominent representatives from the New England Telephone & Telegraph Company, the New York Telephone Company, the Western Electric Company and from the various licensed telephone companies all over the country. In a car at the rear of the train were Gov. Crane, Major Henry Lee Higginson and the members of the class of 1862 at Harvard, of which Mr. Hudson was the first scholar. There were no pall bearers.

The coffin was laid in a bank of flowers, many of them sent by telephone companies located at too great distance to send representatives. The burial took place in Lynn, where Mr. Hudson was born.

The main offices and those of the New England Telephone & Telegraph Company, at 125 Milk Street, excepting the exchange, were closed on account of the funeral of Mr. Hudson.

The Signal Corps in China.

A private letter has been received by an officer in the War Department from Lieut. Stanford, of the Signal Corps, which gives a brief but interesting account of the work of the Signal Corps on the way from Tientsin to Pekin. He says that, owing to lack of transportation, the work of the Signal Corps was very difficult. Gen. Chaffee found it necessary to take every wagon and cart that had been shipped from the Philippines in order to carry the supplies he needed for his army, consequently the signal officers had to skirmish for transportation. Lieut. Stanford says that he picked up teams and carts from any nation that could be induced to part with them, and sometimes few questions were asked as to the real proprietary interest in the transportation outfit. He speaks of the very hot weather which was encountered, so hot that men who were not accustomed to excessive heat suffered severely. One day two laborers with his party dropped dead from the heat.

Notwithstanding all these difficulties, the Signal Corps pushed along, and though Gen. Chaffee was in advance sometimes during the day, the wire was nearly always up with him at night. Lieut. Stanford's party consisted of himself and twelve men of the corps. "The Japs," he says, "were a few miles behind us, with 100 enlisted men and 20 carts for transportation, but I was determined that they should not beat us into Pekin, and they didn't. The first wire there was ours, at the American Minister's house, and the first instrument working was ours. And after that our wire was carrying messages not only for our own Government, but for the Russians, English, French, Italian, German and Austrian Governments, besides the press."

Programme for the Kansas City Convention.

The nineteenth annual meeting of the American Street Railway Association will be held at Convention Hall, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

Papers will be read on the following subjects: "Consolidation of Street Railways and Its Effect upon the Public," by Daniel B. Holmes, counsel, Metropolitan Street Railway Company, Kansas City, Mo.; "A Comparison of the Various Systems of Electrical Distribution for Street Railways," by C. F. Bancroft, electrical engineer, Massachusetts Electric Companies, Boston, Mass.; "Painting, Repainting and Maintenance of Car Bodies," by F. T. C. Brydges, superintendent of car shops, Chicago, Union Traction Company; "The Store Room and Store-Room Accounts," by N. S. Hill, Jr., general manager, Charleston Consolidated Railway, Gas & Electric Company, Charleston, S. C.; "Double-Truck Cars; How to Equip Them to Obtain Maximum Efficiency Under Varying Conditions," by N. H. Heft, president, Meriden Street Railway Company, Meriden, Conn.

Friday, Oct. 19, has been set apart as a day for the examination of the exhibits. No session of the association will be held on that date, so that all may have plenty of time to view the exhibits. It is earnestly requested that managers have their heads of departments present on that day. The annual banquet will be held at the Coates House, Friday evening, when the officers-elect will be installed.

The headquarters of the association will be at the Midland Hotel. The principal hotels in Kansas City and their rates are as follows: Midland, American, $3 to $6 per day; European, $1 to $5 per day. New Coates, American, $3 per day and up; European, $1 per day and up. Savoy, American, $2.50 to $6 per day; European, $1.50 to $3.50 per day. Baltimore, American, $3 to $5 per day; European, $1.50 to $3 per day. All are first class and in close proximity to the hall. The executive committee advises all who desire rooms to apply at once.

The passenger associations have, as usual, granted a rate of one and one-third fare, on the certificate plan, provided 100 or more tickets are purchased. All persons intending to attend the convention are cautioned to get certificates when they purchase their tickets and to deposit these certificates with the clerk upon arrival at the hall. He will have them signed, and will return them, on application, on Thursday, Oct. 18. Under this plan no one can get a return ticket at reduced rates if he fails to secure a certificate when he purchases his ticket, so the importance of this is evident.

The managers of the Kansas City railway systems have arranged a generous programme for the entertainment of the delegates, and a very large attendance is indicated.

Self-Help.

With the countenance of some 4000 of its friends and members, who crowded the vast auditorium, the Metropolitan Street Railway Association celebrated its fourth anniversary on Saturday night, Oct. 6, at Carnegie Hall, in New York City. This association was organized four years ago by the employees of the Metropolitan Street Railway Company of New York City for their own protection. For 50 cents a month it secures to its members free medical attendance, about one-half their usual wages when incapacitated for work by illness, and an insurance of $150. It has paid out since it was organized nearly $44,000 in sick and death benefits. It has a surplus invested in securities of the Metropolitan Street Railway Company, and over $11,000 in bank. It owns a bed in St. Vincent's Hospital, the gift of President Vreeland. It has a circulating library of 1300 books, to which members and their families have access. Its ability to pay $14,000 a year in sick and death claims, as it did last year, is due to the fact that it pays no salaries. Its membership has increased in four years from 100 to 3312. The proceedings at Carnegie Hall opened with an eloquent address by Mr. Vreeland, in his dual presidential capacity, and included an excellent vaudeville.

American Apparatus in France.

There has recently been formed in Paris a syndicate called the Société Française Sprague, with suitable financial backing for making, on a large scale, a practical demonstration of the operation of the multiple unit system of control. Its offices are at 6 Rue de Madrid. The president is Mons. M. Monthiers, and the vice-president is Mons. J. Micart. Among the directors are directors of the Comptoir National D'Escompte, the Banque de Consignation and the Société Breguet.

To carry out the initial purposes of this organization there has been recently shipped to Paris about sixty tons of trucks, motors, controllers, etc., which are now being installed by Mr. Frederick Brush, one of Mr. Sprague's former assistants, on a trial train on the Western Railway of France. When completed, this train will be put into operation on the Versailles division of that road, on the branch running from the Quai d'Orsay. This branch is already equipped with a third-rail supply for about 27 miles, and is supplied from a modern high-powered Westinghouse station at Moulineaux. This is the same line on which two-car train units are now operated, with a hand control at each end, the main controlling circuits being carried from car to car, and for which a number of electric locomotives are being built by four different companies for tests.

It is expected that the demonstration made on this line will be far-reaching in its influence upon railway development on the Continent. In addition to this demonstration, a trial train on the Sprague multiple unit system will, in the near future, be operated on the new Berlin Railway, under the auspices of the Siemens & Halske Company.

The Electric Automobile from a Commercial Point of View—I.—Section 2.

By Robert A. Fliess, E. E.

A TEST IN HEAVY SNOW.

HAVING now considered the electric vehicle under most favorable circumstances, it becomes of interest to know what it may be expected to do under adverse weather conditions.

The test recorded in Table IX gives the result of a run made just after one of the most severe snow storms experienced by the city last winter. The snow lay 4 in. to 5 in. deep in many places, and the run included some of the worst macadam pavement in the city, which at the time it was traveled over was covered with several inches of snow. The worst hills between the Battery and Washington Heights were encountered, and as a whole the trip represents probably the most severe conditions that an electric vehicle operating within the Borough of Manhattan will, under ordinary service conditions, ever be called upon to contend with. The two photographs in which the automobile marked "U. S. Mail" is shown give a good idea of the condition of the streets when the test noted in Table IX took place. The run noted in Table IX included the ground shown in the two photographs while it was in the condition shown, but the vehicle illustrated in the photographs is not vehicle A.

It rained, and the wind blew incessantly throughout the trip, even the few streets in which an attempt had been made to partially clear

FIG. 5.—HEAVY GOING ON BROADWAY.

FIG. 6.—REAR VIEW OF U. S. MAIL WAGON IN SNOW.

off the snow being filled full of slush—making their pavements slippery and wet. The tachometer on this trip, after the first few readings, could not record the instantaneous speed of the vehicle, owing to the snow, slush and wet.

TABLE IX.

[*Vehicle A.*]

Weight of wagon	3,085 lbs.
Weight of passengers and instruments	305 lbs.
Weight of load carried	—
Total weight causing drawbar pull on test	3,390 lbs.

Principal ground covered on test: Broadway, Forty-second Street to 153d Street; 153d Street, Broadway to St. Nicholas Avenue; St. Nicholas Avenue, from 153d Street to 155th Street; 155th Street, from St. Nicholas Avenue to Central Bridge; Macombs Lane, from Central Bridge to Eighth Avenue; Eighth Avenue, from 149th Street to Forty-second Street.

Total distance covered during test	13.4 miles
Total time in motion	1 hr. 37 min.
Average speed while in motion	8.28 miles per hr.
Total watt-hours used on trip	2,595.2
Average watt-hours used per car-mile	193.67
Average watt-hours used per ton-mile	114.26
For a distance of	6.87 miles
Time in motion was	51 min.
Average speed while in motion	8.84 miles per hr.
Number of watt-hours used	1,374.4
Average watt-hours used per car-mile	200.06
Average watt-hours used per ton-mile	118.03
For a distance of	6.53 miles
Time in motion was	46 min.
Average speed while in motion	8.52 miles per hr.
Number of watt-hours used	1,220.8
Average watt-hours used per car-mile	186.95
Average watt-hours used per ton-mile	109.11
Open circuit voltage at beginning of run	96 volts
Open circuit voltage at end of run	89 volts
Drop in 13.4 miles	7 volts
Running voltage at beginning of run	91 volts
Running voltage at end of run	86.5 volts
Drop in 13.4 miles	4.5 volts

With the most trying conditions that it will probably ever be called upon to contest, under ordinary service conditions in the Borough of Manhattan, vehicle A, as shown in Table IX, required only an average rate of power consumption of 114.26 watt-hours per ton-mile, and at the end of this trip its running voltage was over 1.96 volts per cell, and its open circuit voltage was over 2 volts per cell.

For a distance of 6.87 miles vehicle A showed a rate of power consumption of 118.03 watt-hours per ton-mile, and an average speed of 8.84 miles per hour. The route over which this record was obtained included Broadway from Longacre Square (Forty-second Street) to 153d Street. This, with the exception of a short down-grade between Ninety-second and Ninety-sixth Streets, on Broadway, and the grade between 117th and 125th Streets, is nearly all up hill, and includes the long hill between 125th Street and 153d Street, which, for the greater part of its length is a grade of about 4 per cent. All this ground was covered with either snow or slush, and the roadbed

of the long hill above 125th Street was particularly bad. In 153d Street the snow was about 5 ins. deep, and it was also quite as deep in St. Nicholas Avenue. From the conditions which existed on this run it seems as though a well-designed and properly handled electric vehicle might be expected to travel about the Borough of Manhattan under ordinary conditions of pavement and weather with an average rate of power consumption not exceeding 115 watt-hours per ton-mile. That when properly handled under average weather conditions, it should show a lower rate of power consumption than this, it is thought the earlier tests recorded prove conclusively.

INFLUENCE OF OPERATION ON POWER CONSUMPTION.

The manner in which an electric vehicle is operated influences, to some extent, its rate of power consumption, and consequently the distance which it can travel on one charge of battery. To get an idea as to what difference a change in operators makes in the running of an electric automobile, vehicle A was tested for a short distance while being manipulated by a man who had had very little experience in operating electric vehicles, especially in crowded streets. Table X shows the result of this test.

TABLE X.

Weight of vehicle	3,085 lbs.
Weight of passengers and instruments	365 lbs.
Weight of load carried	—
Total weight causing drawbar pull on test	3,450 lbs.

Principal ground covered on test: Fifth Avenue, Forty-second Street to Twentieth Street; Twenty-first Street, between Fifth Avenue and Seventh Avenue.

Total distance covered during test	3.09 miles
Total time in motion	26 min. 25 sec.
Average speed while in motion	7.01 miles per hr.
Total watt-hours used on trip	553.6
Average watt-hours used per car-mile	179.15
Average watt-hours used per ton-mile	103.85
For a distance of	1.55 miles
Time in motion was	15 min.
Average speed while in motion	6.2 miles per hr.
Number of watt-hours used	248
Average watt-hours used per car-mile	160
Average watt-hours used per ton-mile	92.75
For a distance of	1.54 miles
Time in motion was	11 min. 25 sec.
Average speed while in motion	8.09 miles per hr.
Number of watt-hours used	305.6
Average watt-hours used per car-mile	198.44
Average watt-hours used per ton-mile	115.03

The average power consumption noted on this run was 103.85 watt-hours per ton-mile, at an average speed of 7.01 miles per hour. This is a little higher rate than some of the previous tests noted on this vehicle at a considerably higher average speed would lead us to expect it to show. There are several causes for this. First, the man who operated the vehicle during this run had never run an electric vehicle on a crowded street before, and as nearly the entire trip was made on Fifth Avenue during a very busy period of the day, he was very much hampered and at times "flustrated" by the volume of traffic encountered. As will be noted in Table X, the speed for the first 1.55 miles averaged but 6.2 miles per hour, and as nearly the entire distance covered was on more or less of a down grade, it becomes evident that the rate of 92.75 watt-hours per ton-mile shown for this run is higher than proper manipulation would have required. This is more clearly brought out when the result is compared with a result obtained for this same vehicle with an expert operator in charge. In a test already recorded for a distance of a little over 2 miles, vehicle A showed a rate of power consumption of less than 76 watt-hours per ton-mile at an average rate of speed of over 10.9 miles per hour. This record was obtained over ground of a similar character to that over which the test noted in Table X was made.

On the 1.54 miles of the run noted in Table X the same ground covered on the first part of the test was traveled over again in the opposite direction. The rate of power consumption was over 115 watt-hours per ton-mile for this part of the trip at a speed of a little over 8 miles an hour. Again, comparing this result with another obtained while traveling over ground of a similar nature with vehicle A in charge of an expert operator, we find that for a distance of a little over 2.5 miles at an average speed of over 9.4 miles per hour, the average rate of power consumption did not reach 82 watt-hours per ton-mile.

As already noted, one of the causes for the high rate of power consumption shown in Table X was the inexperience of the driver. Another cause was due to the arrangement on this particular wagon of its braking and controlling mechanisms as two separate functions The writer noticed on a number of occasions that the operator was putting on his brake without throwing off the current. The natural result of this was to cause the ammeter to indicate a much higher rate of instantaneous current consumption than the nature of the ground that was being passed over at the time warranted in the light of previous tests. Another prolific source of waste was introduced through nervousness; the operator shutting off the current and putting on the brake many times where a more experienced operator would have found it quite unnecessary—thus causing a much greater dissipation of energy at the brake-shoe than occasion required.

It will be seen from the data presented and from what has been said that the method of operating and manipulating an electric vehicle influences to a considerable degree its rate of power consumption.

EFFICIENCY OF THE BRAKE.

Though the brake, as was pointed out above, may on occasions be superfluous, on others it becomes of the greatest importance, and on its efficiency the lives or safety of the occupants of a motor vehicle depend many times during a trip.

To determine the efficiency of the brakes used on electric automobiles, two vehicles were tested on the steepest grade the writer could find in the Borough of Manhattan. The grade selected was the one

FIG 7.—ON BROADWAY. IDEAL CONDITIONS FOR A RUN.

between 102d and 103d Street on Lexington Avenue. It is only a block long, but measures practically 14 per cent for its length. It is steeper than any grade up or down which an electric vehicle in commercial use will probably ever be called upon to travel in the borough.

Vehicle A was taken up this grade with ease, and on a second trip up the grade was brought to a stop half-way up and held in a stationary position without trouble. The vehicle was then started forward, and later was backed down to the base of the hill, under perfect control all the time.

The instantaneous readings of power consumption obtained at a point on this hill and at a point on a hill not quite as steep follow:

Voltmeter reading.	Ammeter reading.	Speed in miles per hour, approximated.	P. c. grade at point of reading.
85	80	2.5	13.5
85	57	3	9.5
85	59	3	9.5

Both of the hills are paved with cobblestones. After the test on the 14 per cent grade, the commutator was examined and was found to be cool. Another vehicle of a little heavier build than vehicle A was taken up and down the 14 per cent grade with ease, and it was stopped and started on the hill without trouble. It would seem, therefore, as though the brake question, as far as the Borough of Manhattan is concerned, has been satisfactorily solved. Also, that the ability of electric vehicles to climb any grades they are likely to encounter while engaged in ordinary commercial service in the Borough of Manhattan would seem to have been demonstrated.

A TEST ON A PLEASURE VEHICLE.

Thus far, only electric vehicles designed for use in light delivery service have been noted. To determine if the results obtained on such vehicles are applicable to vehicles with a different body con-

struction, several vehicles designed for pleasure purposes were tested. Table XI gives a brief synopsis of part of one of these tests.

TABLE XI.
[*Vehicle D.*]

Weight of vehicle	1,165 lbs.
Weight of passengers and instruments	305 lbs.
Total weight causing drawbar pull on test	1,470 lbs.
For a distance of	3.31 miles
Average speed while in motion	9.68 miles per hr.
Average watt-hours used per car-mile	63.32
Average watt-hours used per ton-mile	86.14
For a distance of	2.35 miles
Average speed while in motion	6.79 miles per hr.
Average watt-hours used per car-mile	73.53
Average watt-hours used per ton-mile	100.04

From Table XI it would seem as though all conclusions based upon results obtained while testing electric delivery wagons are applicable to electric vehicles with any design of body. A comparison will bring this out more clearly.

The section of the run noted in Table XI, which covered 3.31 miles, was over the same ground covered by vehicles A, B and C in tests already noted. They required, respectively, 82.13 watt-hours per ton-mile, 69.83 watt-hours per ton-mile, and 83.11 watt-hours per ton-mile at speeds of 9.83 miles per hour, 11.31 miles per hour and 10.14 miles per hour, to cover the same ground, with the asphalt pavement in good condition, and dry. The result given in Table XI, on the other hand, was obtained on wet and slippery asphalt. It would seem, therefore, as though the assumption that the results obtained while testing electric delivery wagons are applicable to electric vehicles with any design of body, is justified. Another point which the test noted in Table XI would seem to settle is that the results of tests obtained while testing heavy vehicles are applicable to vehicles of a very much lighter construction.

The second section of the run noted in Table XI, which covered 2.35 miles, gives results obtained during a rain storm, while the top of the vehicle was up, and while it was running against the wind, which accounts for the increased power consumption noted.

BATTERY EFFICIENCY.

As recorded in Table I, the efficiency of the battery used in vehicle A was found to be 68.67 per cent at the end of that run. This battery was in very good condition at the time these figures were obtained. From a comparison of this and other tests of a similar nature made during this investigation, and from a consideration of the nature of the work required of batteries used in vehicles designed for use in light delivery service in the Borough of Manhattan, it is thought that an efficiency of 70 per cent represents very closely the true average commercial efficiency that may be expected of batteries in general in this class of service, when handled with proper care, and when they are not often discharged below a running voltage of 1.75 volts per cell on a trip.

From a consideration of the test recorded in Table VII and of the curves presented in Plate I, it would seem as though an electric vehicle engaged in light delivery service in Manhattan should be able to cover at least 22 miles with the average load carried by vehicles in this class of service, before its running voltage drops below 1.75 volts per cell. This, however, will only be possible in regular service when the battery is kept in proper condition and receives careful attention. The effect of improper treatment of electric storage batteries used in electric vehicles is to cut down the mileage of the vehicle very much, as well as its speed, and to shorten the useful life of the battery.

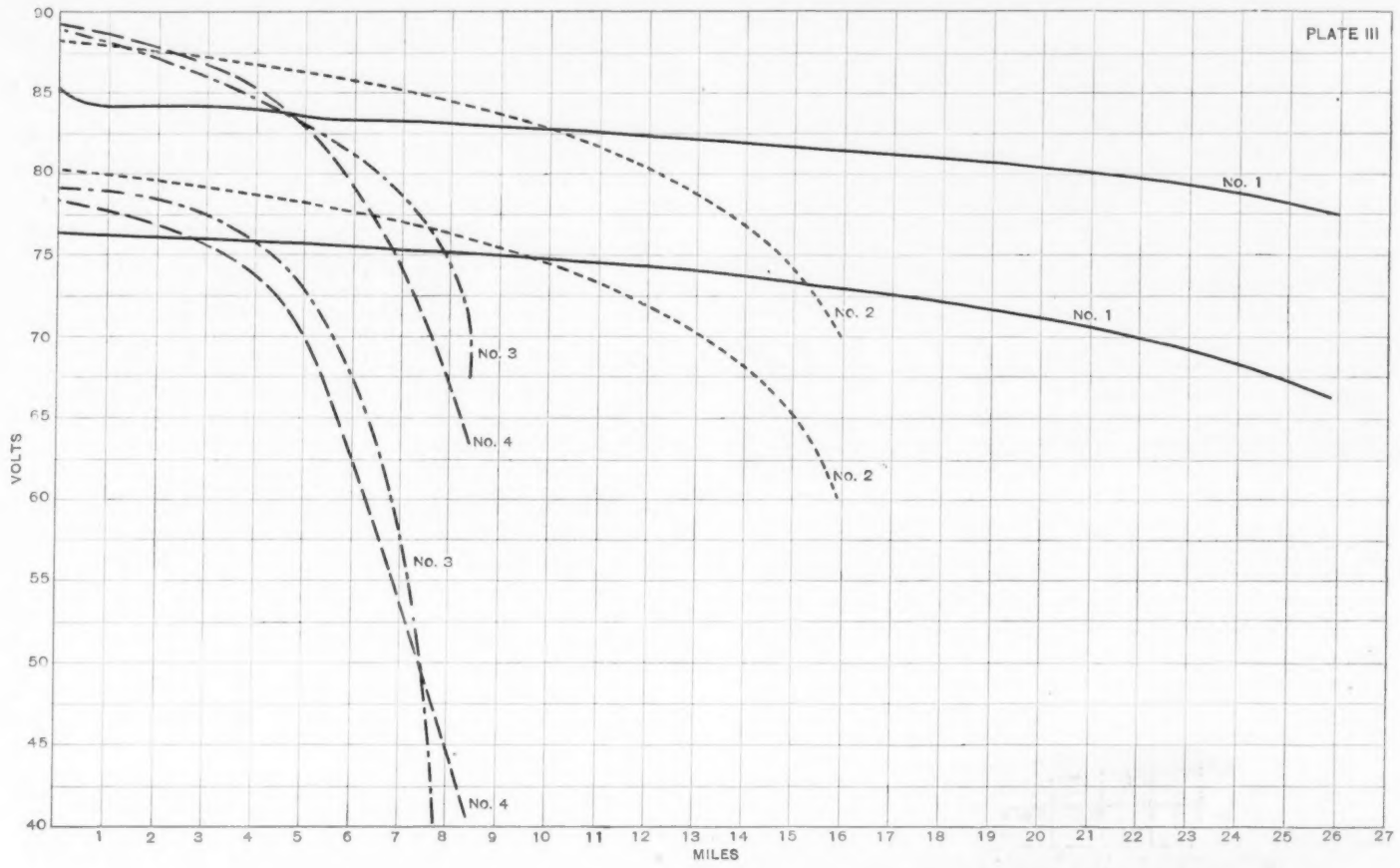


PLATE III.

THE EFFECT OF IMPROPER TREATMENT OF STORAGE BATTERIES.

The curves presented in Plate III illustrate these points very clearly. This plate shows curves obtained from three different vehicles equipped with the same make of storage battery. Curves No. 1 are plotted from results obtained while testing a vehicle which ran, as will be noted, something over 26 miles, and its running voltage was still over 1.75 volts per cell when it reached its twenty-second mile. The curves are plotted with volts as ordinates and with miles as abscissæ, as in Plate I. Curves No. 2 represent the results of a test on an electric vehicle which covered on the test a distance of 16.24 miles at an average speed of 9.44 miles per hour. This trip included the long hill starting at 125th Street and Broadway and ending at 153d Street, and the vehicle covered sections of the Borough of Manhattan between Twentieth Street and 155th Street on this trip. The battery of this vehicle was not in as good shape as the one carried by the vehicle represented in curves No. 1. The running voltage at the end of the trip had dropped to 1.5 volts per cell, and the open circuit voltage to 1.75 volts. Curves No. 2 illustrate what may be expected of batteries that are not carefully taken care of.

Curves No. 3 show the result of a test on a vehicle the battery of which had been standing in the vehicle unused and not properly cared for for some time. The open circuit voltage before the start indicated that the battery had a good charge in it—the voltage per

cell showing a pressure of over 2.2 volts. It soon became evident, however, that the battery had lost, while standing unused, the greater part of the last full charge put into it. The running voltage, as may be noted, had dropped at the end of 7 miles to a pressure of 1 volt per cell, which, of course, is not permissible as a regular thing.

Curves No. 4 show the result of a test with the same battery after it had received a good charge. This test was run under adverse weather conditions. The battery probably would have shown up a little better if this had not been the case. The battery was kept on charge after this run for 4 hours before it was fully charged, though the vehicle had run but a little over 8.5 miles during the test. Its efficiency on this occasion was found to be but a little over 23.7 per

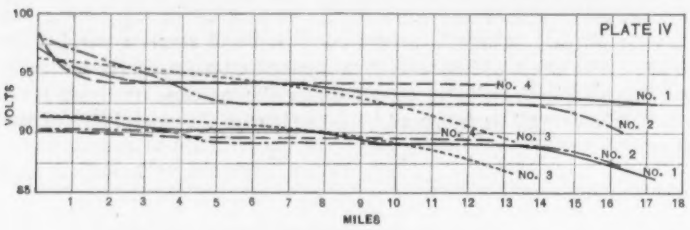


PLATE IV.

cent. Of course, this is not the efficiency of the battery when in good shape, but it illustrates the importance of keeping the batteries of electric vehicles well charged, even when not in actual use.

If the battery is put on charge as soon as possible after each trip, and if it is charged a little every day or two, whether the vehicle has been used or not since its last full charge, such results as are shown in curves Nos. 3 and 4 will not take place.

The curves in Plate IV illustrate what may be expected of a battery in good condition and which receives proper attention. These curves represent the results obtained while testing vehicle A under various conditions. The same battery was used on all the tests.

Curves No. 1 are plotted from the readings obtained for open circuit voltage and running voltage, while testing vehicle A on the run recorded in Table VII. Curves No. 2 represent the results ob-

FIG. 8.—AT 155TH STREET, NEAR CENTRAL BRIDGE.

tained during a test on vehicle A not recorded in the body of this article, as it merely duplicated the results already presented. Curves No. 3 show the result of the open and closed circuit voltage readings for the test recorded in Table IX. As was noted when discussing this test, the running voltage was over 1.96 volts per cell at the end of this run, which, as will be remembered, was a more severe test than an electric delivery wagon will probably ever be called upon to undergo in regular commercial service in this borough.

Curves No. 4 are for the test recorded in Table VIII. It was on this test that vehicle A was equipped with pneumatic tires. It is thought that the curves of Plate IV illustrate the consistent results which may be expected of a battery under most varied conditions when it is properly cared for.

The excessive drop easily noticed in open circuit voltage curve No. 4, Plate IV, which took place at the beginning of this run, is, of course, accounted for by the fact that the battery had just been taken off charge when the highest reading noted—the open circuit voltage at the beginning of the run—was taken. This explains several of the other high open circuit voltage readings also.

A CONCISE RÉSUMÉ.

Table XII presents a concise résumé of the results obtained on twelve separate tests over the same ground with four different vehicles under various conditions. These have been collected from the different tables already presented, and, it is thought, should lend weight to the value of the data that have been presented, on account of the very consistent results obtained, as shown in this table. As has been previously stated, great care was taken to obtain accurate results, and all the data that have been presented were carefully checked against the various calibration curves obtained when comparing the instruments used against the standard instruments of the Electrical Engineering Department of Columbia University. It is believed that the results presented represent very closely the conditions which it was desired to determine.

TABLE XII.

Distance Covered in Miles.	Speed in Miles Per Hour.	Watt-hrs. Used.	Watt-hrs. Per Car-Mile.	Watt-hrs. Per Ton-Mile.	Weight Causing Draw Bar Pull.	Time in Motion.
2.62	10.14	494.4	188.7	83.11	4525	15.5
2.67	10.68	489.6	183.37	81.02	4525	15
2.57	9.44	414.4	161.24	80.31	4015	16.25
2.61	11.18	396.8	152.03	81.87	3714	14
2.64	11.31	342.4	129.69	69.83	3714	14
2.63	10.52	336	127.75	68.79	3714	15
2.52	10 8	356.8	141.58	83.52	3390	14
2.54	9.83	353.6	139 22	82.13	3390	15.5
2.55	10.31	339.2	133.02	78.41	3390	14.8
2.55	10.93	328	128.62	75.88	3390	14
2.56	10.24	384	150	89.42	3355	15
3.31	9.68	209.6	63.32	86.14	1470	20.5

Several other tests besides those noted in this article were made by the writer, but have not been given, as the results obtained simply duplicate those already presented. All the tests made, have, however, been considered in forming the final conclusions which have been reached. These, as was stated at the beginning of this section of this report, are based upon over 250 miles of tests with electric vehicles of six different makes. Ten vehicles of various weights and designs of body were employed. The results that have been reached are based entirely upon original data and are considered from the point of view of light delivery service, as it is thought that if electric vehicles can compete successfully from a commercial point of view with the horses and wagons engaged in this class of service they can surely compete successfully with public and private cabs in large cities.

CONCLUSIONS REACHED.

From the data presented and from what has been said, it would seem as though electric vehicles designed for use in light delivery service in the Borough of Manhattan can be expected to cover at least 22 miles on one charge of battery at an average speed while in motion of at least 8.5 miles per hour under ordinary service conditions when carrying the average load required of vehicles in this class of service. Also that they can be expected to do this with an average rate of power consumption seldom exceeding 115 watt-hours per ton-mile and with an average battery efficiency not often less than 70 per cent if the running voltage is not often allowed to drop below 1.75 volts per cell on a trip—this when the vehicle is equipped with solid rubber tires.

Chicago Drainage Canal Water Power.

The Chicago Council passed an ordinance providing for the utilization of the water power of the Chicago drainage canal at Lockport for lighting the city. Whether the city will do this or not will depend on whether it can obtain a favorable decision in a case raised to determine the legal limit to the city's bonded indebtedness. It will be necessary, if the city develops the water power, for it to issue bonds to the amount of $2,500,000. The ordinance as passed provides that the city pay $4 a horse-power to the drainage board for the first year with an appraisement for each following year. The contract provides that the city shall use the power only for municipal purposes.

Some British Engines and Dynamos at the Paris Exposition.

In the British section of the foreign power house are four different exhibitors with as many types of engines. Willans & Robinson have their well-known central-valve engine; Galloways have a semi-enclosed vertical compound engine, Robey & Company, of Lincoln, have a horizontal cross-compound engine, and C. A. Parsons & Company show two of their steam turbines. The Robey unit has already been illustrated and described in these pages. The accompanying engraving is made from a photograph of the Galloways engine direct connected to a 350-kw shunt-wound generator by Mather & Platt, of Manchester, England. The engine cylinders are 18 ins. and 34 ins. diameter, with 36 ins. stroke, and at 105 r. p. m. and with 150 lbs. of steam an output of about 680 horse-power is possible. Corliss valves are used, worked by two eccentrics at each end of the shaft outside the pedestals. These valve shafts are provided with cranks which operate oil pumps, giving forced lubrication to all running parts of the engine. The generator is intended for power or lighting circuits, giving 1400 amperes at 250 volts; shunt winding is used. The yoke is of cast-steel, with 12 poles, and is made in two parts bolted together. For inspection of the armature the upper half may be removed, two eyebolts being provided for lifting it off. If it is required to reach the under part of the armature, the lower half of the field may be let down; this being accomplished by removing the brackets on which it rests, when the field casting may be lowered as far as may be necessary. The field spools are made entirely of brass, and the outer flange has two lugs on each side, through which bolts pass horizontally to the yoke to secure the spool in position. The field magnets are deeply hollowed out at the back to obtain reduction of weight; no polar extensions are used on the faces. As the machine is intended for power as well as lighting, a slotted armature is used, with drum winding, bar conductors being laid in insulated grooves in the usual manner. An 11-ft. fly-wheel is keyed to the shaft, and the armature spider is mounted alongside. Instead, however, of keying the armature to the shaft, it is bolted to a 40-in. flange forming an extension to the fly-wheel hub. The strain due to sudden irregularities in load is thus transferred from the shaft to the more solid framework uniting fly-wheel and armature. A special form of carbon brush is used, made of a T-shape, with beveled edges to the arms of the T, by which it is clamped in place in a pivoted holder. Twelve sets of brushes are provided, five in each set. The brush holder studs are held in lugs on cast-brass rings encircling the commutator, these being in turn supported and protected by a larger cast-iron ring which rests on six brackets bolted to the field frame. Adjustment of the brushes for the neutral point is obtained by means of a hand-wheel and screw, the outer ring being thus moved within sufficient limits. The field rheostat is placed below the engine room floor, and is operated by a small hand-wheel furnished with a pointer and dial, these mounted on a cast-iron standard close to the dynamo. The total or combined efficiency of this plant is given as about 85.5 per cent.

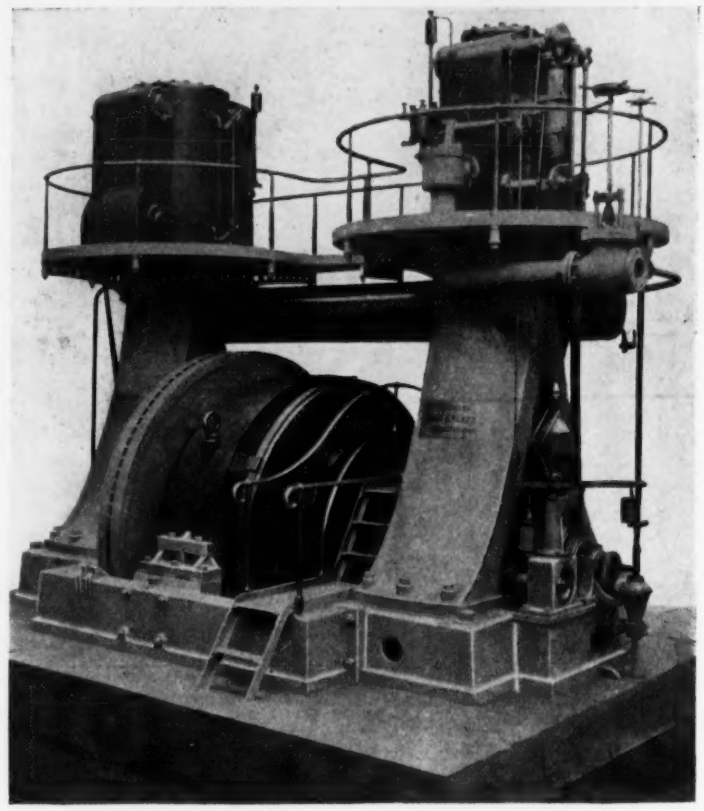


FIG. 2.—500-HP GALLOWAYS ENGINE AND 350-KW MATHER & PLATT DYNAMO.

Steam turbines have generally been regarded hitherto as wasteful investments, on account of their alleged excessive use of steam, and the various attempts to build rotary steam engines without reciprocating parts has further served to bring such machines into bad odor with engineers. It is not many years ago, however, that a new form of turbine was introduced, which gave promise of a much better future than preceding types. This was the Parsons turbine, in which two series

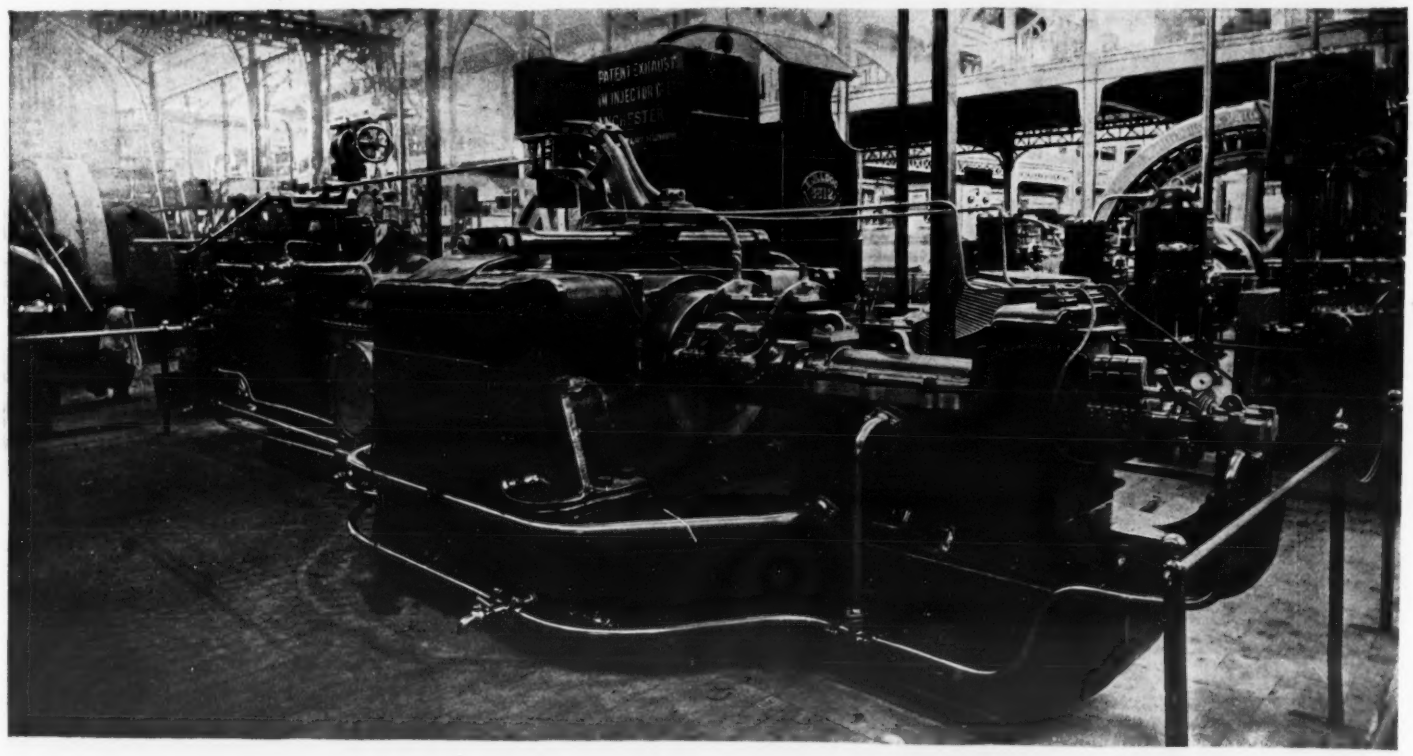


FIG. 1.—500-KW PARSONS TURBO-ALTERNATOR. BRITISH SECTION.

of blades are used, every alternate ring of blades movable and connected to the main shaft, the others being fixed, and placed diagonally so that the steam acts to produce a rotary motion of the movable part

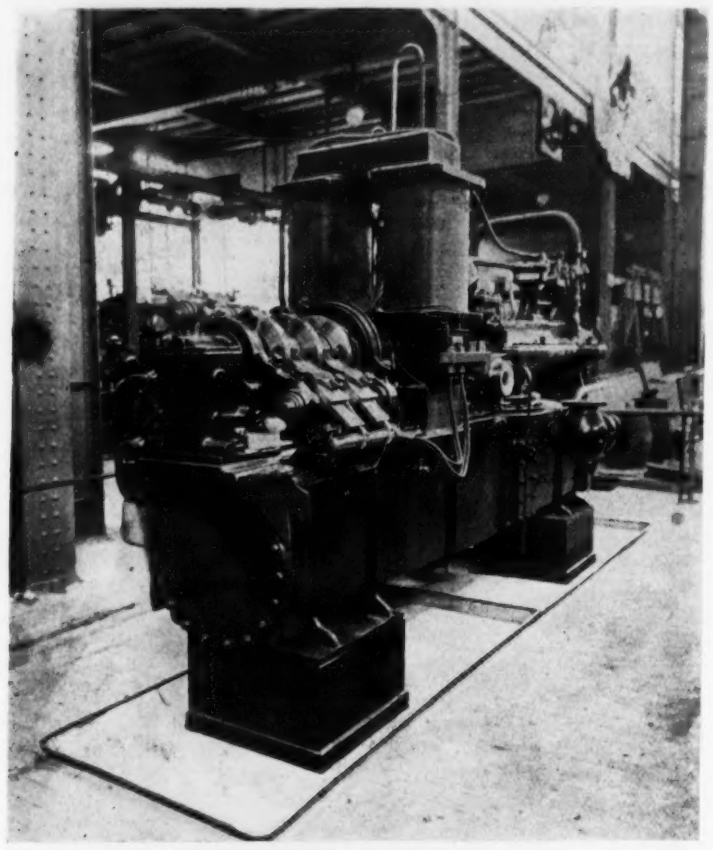


FIG 3.—PARSONS TURBO-GENERATOR.

when passing through the series. This may be considered a development of the low-pressure water turbine, in contra-distinction to the high-pressure impact turbine which has been the principle followed in some other cases. C. A. Parsons & Company, of Newcastle-on-Tyne, have on exhibition two steam turbines direct connected to dynamos, one of 500 kilowatts and one of 70 kilowatts. The larger one drives a 4-pole alternator and the smaller one a continuous current generator, both at 3000 r. p. m. The 70-kw turbine-generator is mounted upon a base forming a surface condenser, so that the condensing steam plant is self-contained. One of the reasons for the high economy secured with this turbine is that the condensed steam may be returned directly to the boiler; for, since none of the moving parts in the cylinder touch against stationary parts, no oil is required, and the water of condensation remains pure. Another noteworthy feature of the turbine is that it is not necessary to provide foundation bolts, as there is no tendency for the machine to creep, and it may be placed on stone blocks, where its own weight will keep it in place. The commutator of the continuous-current machine is supported at its centre by a steel ring, to keep the segments from flying out. Additional collecting surface is obtained by turning V-shaped grooves throughout the length of the commutator, and brass wire brushes are used to collect the current. The brush holders and rocker arm are exceptionally heavy, even for British design. The dynamo is of the inverted bipolar type, shunt wound. Regulation is obtained within very close limits by an electrically-controlled steam admission valve, whose closing is determined by the position of a lever under the influence of an electromagnet in shunt across the brushes. Compounding is secured by a series turn which opposes the shunt winding on the electromagnet. On a recent test a load of more than 70 horse-power was thrown on and off without producing more than one volt difference in the e. m. f. at the brushes, the machine running at 130 volts. The working steam pressure for the 70-kw turbine-generator is 110 pounds, and for the larger one 140 pounds. This latter machine is intended for use with a separate condenser, and is not shown in operation at the Exposition. The alternator has four poles, giving therefore a frequency of 100 p. p. s. at 3000 r. p. m. A small two-pole exciter on an extension of the main shaft provides current for the field. The electric regulator is of a slightly different construction from the continuous current pattern, a series coil being placed above the shunt coil and drawing up a core connected to the steam regulator when the current increases. The collector rings of the alternator are mounted on a varnished wood cylinder. The e. m. f. between terminals is 2000 volts. Forced lubrication for the bearings is used, oil being pumped from a reservoir through pipes on the outside of the frame.

An application of the Parsons turbine to marine work is well shown in the case of the "Turbinia," a torpedo boat at present stationed in the Seine, just off the Army and Navy Building of the Exposition. A recent test down the river showed a speed of nearly 30 knots, but the boat will do even more under suitable conditions.

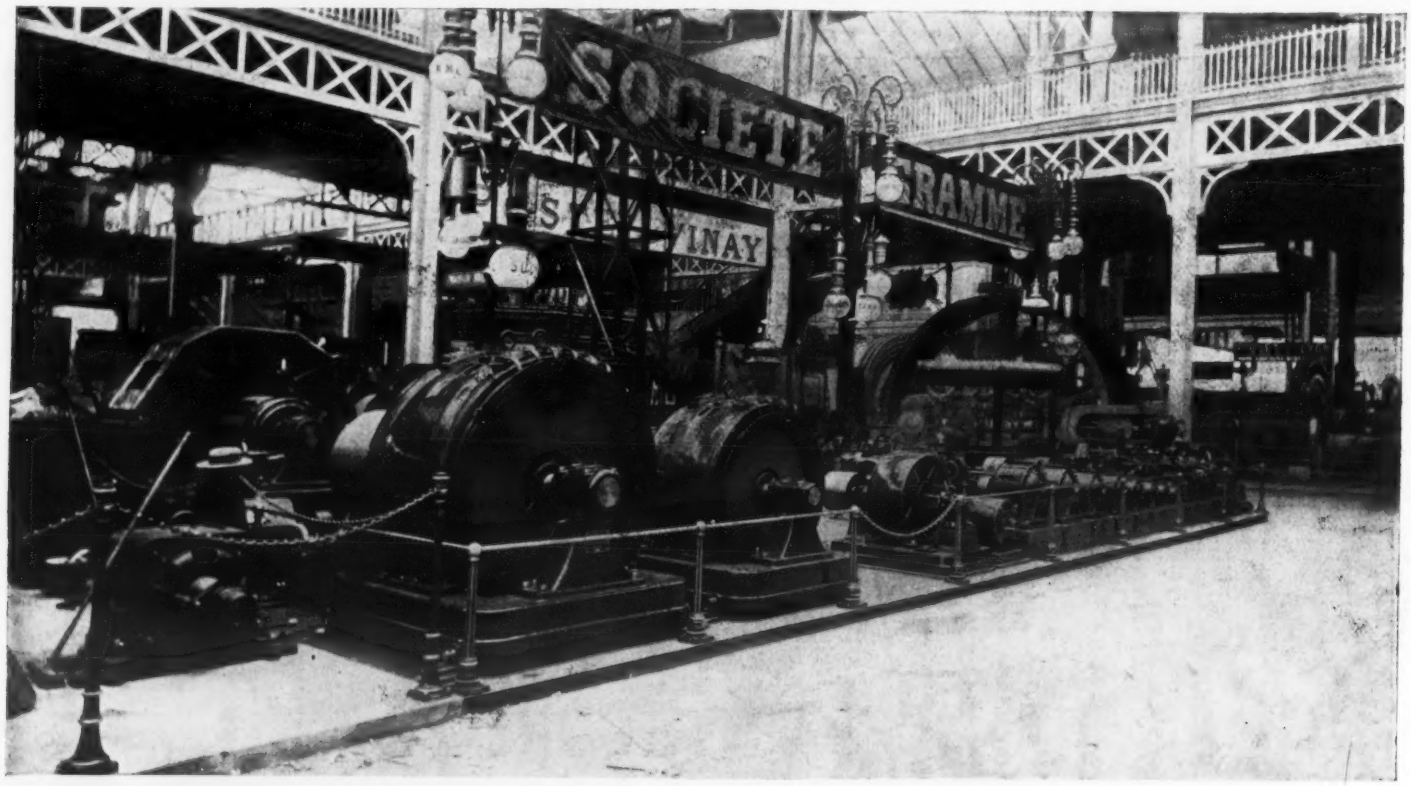


EXHIBIT OF THE GRAMME COMPANY, ELECTRICITY BUILDING. (SEE PAGE 569.)

The Gramme Exhibit at the Paris Exposition.

The name of Gramme is so closely connected with the development of electric machine design, particularly in Europe, that it is natural to expect and find an extensive exhibit by the company now manufacturing the apparatus originally conceived by that inventor, together with many new departures necessitated by common progress in the electrical field. Gramme himself, though still alive, is an old man, who cannot take the same active part in the work that he did twenty or thirty years ago. The exhibit here shown comprises a series of bipolar generators from ½ horse-power to 54 horse-power, three 4-pole machines, a plating dynamo, single-phase and three-phase alternators, induction motors, rotary and static transformers and other machines. In the near corner is a 300-hp three-phase alternator, and next to it a 100-hp single-phase alternator. The general design of the two machines is quite similar; a double armature is used, with an internal double revolving field with stationary central field coil. Two terminal boards are on each side, on the upper part of the circular frame, and good connections are brought up from the copper rings which take current from the armature winding. The connections to the terminal blocks are made by simply clamping the copper strips between brass plates, and the only provision for making electrical contact to the outgoing cables is in the same manner. This appears to be a relic of old-time laboratory practice, and may be actually seen in some of the Gramme machines in the historical or retrospective section.

Next to the smaller alternator is a 25-kw rotary converter, taking alternating current at 110 volts and 42 periods and delivering continuous current at 150 volts for charging accumulators. A series of three-phase induction motors follows, from one-tenth to 10 horse-power, with squirrel cage rotors. Above 10 and up to 30 horse-power the winding is arranged for insertion of resistance at starting.

The bipolar machines of the Gramme Company (Société Gramme) show solidity of construction, even though their design may be essentially different in some respects from our own practice. The field magnets are of cast steel, particularly massive at their tips, producing a strong field at that part and consequently more uniform distribution of magnetic lines of force than is obtained with more tapering pole tips. The cross-section of the field cores is rectangular, which requires more wire than a circular cross-section of the same area. The brush-holder supports are bolted to an adjustable rocker arm on the journal box; the brushes are of copper gauze held from spreading at the ends by sheet brass clips on steel leaf springs fastened to the brush-holders, this same means being applied on one of the old dynamos for retaining copper wire brushes. Self-oiling bearings are used, with two oil rings at the pulley end and one oil ring at the commutator end. Three multipolar dynamos are exhibited, having drum-wound slotted armatures, and from four to ten poles, according to the output of the machine.

Two bipolar plating dynamos are shown, one of 165 amperes, the other of 1000 amperes capacity at 5 to 7 volts. The larger one has two commutators, one on each side of the armature, with four pairs of copper gauze brushes each. In this case proper cable tips are used to make contact with the brush-holder studs.

Motors have been applied by the Gramme Company to machine tools, elevators, automobiles, etc. A small portable forge exhibited is provided with a motor in the lower part to give the air blast, this construction being neat and practical, as the motor is sheltered against any chance injury. A milling machine has the motor mounted on the top of the column and it is entirely enclosed, the motion being transmitted to the cutter by a bevel gear, and the travel of the table being obtained by a belted connection between pulleys at the back. For elevator service the motor is carried on a frame which supports also the starting box and gears, forming a compact arrangement in which space is well utilized. Many applications of motors are made to machine tools, in general not very different from practice universally employed for small work.

PARIS EXPOSITION NOTES.

The Metropolitan Railway was intended to be completed in time for use during the summer of 1900 to assist in handling the enormous crowds flocking to and from the Exposition, and the first section, opened in July, was of great service in transporting visitors when their numbers began sensibly to increase. It is announced that the short branch from the Trocadero to the Place de l'Etoile is now ready for operation, and will be at once opened to the public. This will provide another means of relieving the pressure at one of the Exposition exits, where there is a great lack of vehicles during the rush hours of the evening. On the main line of the Metropolitan trains are now running at five-minute intervals during the day, between the hours of 7:30 a. m. and 8:30 p. m. From 5:30 a. m. to 7:30 a. m. and from 8:30 p. m. to 9:30 p. m. trains run every six minutes, and from 9:30 p. m. to 12:30 a. m. every ten minutes.

Twenty Thousand Mayors.—The occasion of the visit to Paris of 20,000 mayors from the provinces of France afforded the Exposition authorities an opportunity to illuminate brilliantly the grounds and buildings in honor of their friends. Not only was the Exposition shown at its best, but all Paris was lighted and decorated, and the intentions of the official programme appeared to be even more comprehensive than that undertaken for the benefit of the Shah. It was intended originally to have a nautical fête on the Seine, with fireworks and decorated boats, but it seems that a dread of fire has arisen rather late in the day, and fireworks are too dangerous, notwithstanding the regulations which have been introduced requiring fireproofing of everything combustible.

With Shortening Days the Exposition authorities have decided that the public need not be admitted to the buildings to so late an hour as 7 p. m., and the hour of closing is put at 6:30, with a probable change very soon to 6 o'clock. This proceeding saves a good deal of expense which would otherwise be necessary for illumination, and the public is allowed to walk up and down Machinery Hall, because that part must be lighted in order to have the engines running, or they may go out into the Champ de Mars enclosure and wait for the illuminated fountains, which play at 9 o'clock.

Some Administration Peculiarities give rise to adverse criticism, such as was freely expressed in the early days when there was much apparently unnecessary trouble and delay over the connection of the engines to the steam mains in the foreign power house. A specified contractor was, according to the regulations, to have in charge the laying of the mains. In the Italian section the engines were ready for running before the steam pipes were down, and one of the exhibitors requested the official contractor to do his work. He, however, was not ready to do it then, and the exhibitor in question did it at his own expense, after which he was presented with a large bill from the contractor for the same work, and was obliged to pay it, even though the contractor had done nothing at all.

Automobile Club New Headquarters.

The plan to secure a suite of half a dozen rooms in the Astor Court Building, New York City, fronting on Thirty-third Street, by the Automobile Club of America for its headquarters during the coming year has fallen through, and other arrangements are now under consideration. The membership has increased very rapidly during the past twelve months. The active list now contains 225 names. The new quarters are by no means destined to be permanent, for the members are ambitious to own their own clubhouse at an early date, and within another year the automobilists may occupy an elaborate home of their own, where a large charging station can be provided for electric vehicles. The club will be one year old on Oct. 16, the anniversary of the adoption of its constitution and by-laws. The first meeting to organize was held June 7, 1899.

At the last meeting of the executive committee it was voted to take an active and energetic part hereafter in the defense of any member or affiliated member whose rights on the highway have been assailed, or whose privileges have been in any way curtailed unlawfully or menaced by hostile legislation, whether State or municipal.

The coming automobile exhibit in Madison Square Garden is occupying the club's chief attention just at present. It will be held during the first week in November, and every inch of floor space was rented many weeks ago. The exhibit committee will open an office in the Garden for the work. The technical committee of the club is arranging a series of tests, such as stopping, starting, turning, avoiding of obstacles and grade climbing as one of the exhibition features, and a larger test of the same character will be held in some public square of the city at the close of the exhibition. Mr. A. L. Riker is in charge of this part of the programme.

A good many of the members believe that the most practical work that the club can do is to push the fight for better roads. Mr. J. M. Hill has been elaborating an excellent programme in this respect, and one which it is hoped the club will support and promote for its own sake. The matter will be brought forward prominently this winter.

The annual meeting of the club is fixed for Oct. 22. The following nominations for officers have been made: For president, A. R. Shattuck; first vice-president, Gen. G. M. Smith; second vice-president, J. Dunbar Wright; third vice-president, D. W. Bishop; treasurer, W. E. Buzby; secretary, Whitney Lyon; governors for class of 1903, A. C. Bostwick, C. P. Doelger and D. H. Morris.

Mistakes in the Rating of Electric Lamps.*

BY PROF. ARTHUR J. ROWLAND.

A look about us at incandescent lamps installed for lighting service will readily show that 85 to 90 per cent of those used are put in place with base upward, or tipped end downward; and it is the light which comes from the tipped end of the lamp which is useful. In cases where the lamp is installed in a different position, either the lamp is subordinated to some artistic feature of the electrolier, or the lamp is installed "side on" to better keep it out of the way. It is commonly assumed that 16-cp lamps are giving 16 candle-power below them.

In practice one may distinguish three sorts of lighting. First, that in which the light is intentionally concentrated at certain points. Examples are to be found in the lighting of a library, where it is the library table which is to be lighted; or the lighting of a bed-room, in which the bureau or dressing table must have the light concentrated about them; or the lighting of mills and factories, in which the machines are to be lighted. In each of these cases the light which passes out of the lamps beyond a small angular distance from the tip is only useful in dissipating general darkness, helping to break up shadows, and (after reflection) in producing diffusion. The higher the lights are above the object to be lighted the more nearly true is it that the light directly out of the end opposite the base is the only useful light.

Second. That in which a uniform distribution of light is required, as in concert halls, or auditoriums of various sorts, and in shops for the sale of merchandise. In such lighting a close examination of the illumination produced by the individual lights shows that all light from the lamp which streams out above a horizontal plane through it and clear down to 45 degs. below the horizontal—even when the light is only 5 ft. above the objects to be lighted—is valueless for direct lighting. If lights are higher, the useful light is more nearly from the lamp end alone.

Third. That for decorative purposes, in which each case is different from any other, and so need not be considered here.

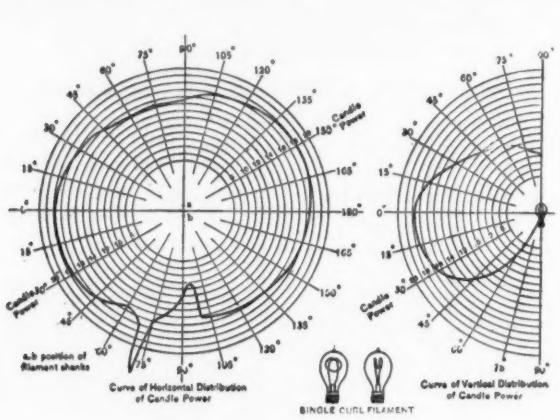

Candle Power
a-b position of filament shanks
Curve of Horizontal Distribution of Candle Power
Curve of Vertical Distribution of Candle Power
SINGLE CURL FILAMENT

FIG. 2.

The light below the lamp—that from the tipped end—is, then, the important and useful light in all practical cases. This is true, too, not only in the specific cases cited, but where large electroliers with many lights are used as well; for in such cases the lamps are usually flared out, with axes at some angle approaching 45 degs., in which case high candle-power from the tipped end and low from the sides of the lamp would contribute to a good, even illumination of the room.

The importance of procuring high candle-power below the lamp has been recognized for a long time. Nearly all reflectors are used on lamps for this very purpose. While reflectors have their place in lighting, for most purposes they are exceedingly poor and are used in ignorance of the effects they produce or because no better device for light redistribution can be had. No matter whether the reflector covers the lamp or not, no matter whether it is of porcelain, a glass mirror, or a polished metal surface, it inevitably cuts the light off absolutely in some directions and so directs it in others as to produce sharp shadows and brilliant lighting contrasts. Reflector lamps, in which the reflector is combined with the lamp, have been introduced to procure the same result, but are in use to a very, very limited extent. They are expensive to use and have the defects of lamps used with reflectors, with no advantages to offset them.

*Abstract of a paper delivered before the Franklin Institute, Philadelphia, at the stated meeting, Wednesday, Sept. 19, 1900, by Prof. Arthur J. Rowland, of Drexel Institute, Philadelphia.

The common use of reflectors and similar devices is evidence that the ordinary incandescent lamp does not give as much light below it as is required there. Is there, then, a bad light distribution from them? An examination of modern lamps will tell us.

There are five different types of filament in use to-day by various prominent lamp manufacturers, and in most cases a filament type indicates the product of a certain manufacturer who has adopted that as the one used in his standard lamps. These typical filaments are enough different from each other to show interesting individuality. I have classed them as follows:

(*a*) Straight U-shaped filament; a type rapidly passing altogether out of use.

(*b*) Single curl filament; a type much used, having a circular loop in the filament midway of its length. This type was originally designed to render filaments stiffer and less liable to bend without an anchor, and also to shorten the lamp bulb. It was found to give a better distribution of light than type *a*.

(*c*) Long curl anchored filament; a type differing from type *b* in that the loop is long in the direction of the lamp axis and is anchored to the part of the lamp where the leading-in wires pass through the glass.

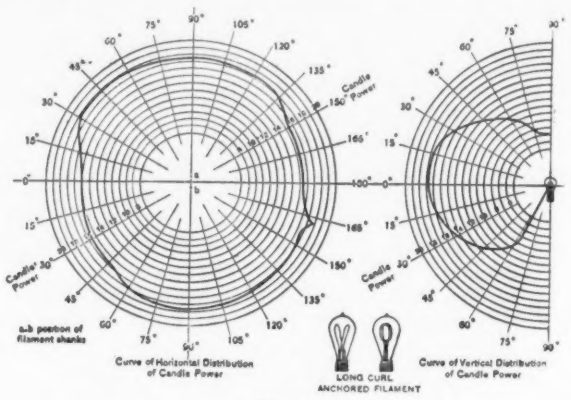

Candle Power
a-b position of filament shanks
Curve of Horizontal Distribution of Candle Power
LONG CURL ANCHORED FILAMENT
Curve of Vertical Distribution of Candle Power

FIG. 3.

(*d*) Double filament; a type which uses two filaments like type *a*, set so the current passes through them in series, the filaments being in planes approximately parallel.

(*e*) Double coil filament; a type like *b*, except that there are two turns in the coil instead of one.

Besides being typical in the matter of general form, the light distribution observed from these various filaments is also typical. It is, however, considerably influenced by the exact relation of different dimensions in the filament itself used by particular firms; as, for example, the diameter of a coil or the spread of the filament shanks. Results below are therefore departed from somewhat if different makes of lamps had been used in the tests.

Fig. 1 gives the relative amount of useful light from filaments of the different sorts expressed in per cent of the light given by the double coil filament (type *e*). The differences are striking. There is no question but that the 16-cp lamp with filament of type *e* is a far better lamp for general lighting purposes than any other. It is almost beyond belief that such a matter has escaped notice in all the years incandescent lamps have been made and used. I first had my own attention called to it by the Shelby Electric Company, for whom I was making some tests of candle-power. It is their lamps I show as type *e*. The Shelby lamps tested were tipless, but the gain in candle-power by omitting the tip is not over 12 per cent.

Filament.	LIGHT IN GIVEN DIRECTION IN PER CENT.	
	Vertically Downward.	30° from Vertical.
Double coil filament.....	100.	100.
Double filament.....	44.0	63.4
Long curl anchored filament...	63.7	72.4
Single curl filament.....	70.6	81.3
Straight U-shaped filament.....	51.4	73.2

FIG. 1.

What folly it turns out to be to use special devices to turn the light downward when the lamp itself can have the filament constructed so as to give a proper light distribution.

(Prof. Rowland showed curves, Figs. 2 to 5, of light distribution peculiar to each of the types of filaments mentioned.) The rough sketch of the lamp on each figure showed very nearly the actual shape of the filament whose candle-power was measured. The figure showed also the lamp as it stood for measuring the horizontal candle-power at 0 degs. and the right-hand figure at 90 degs. In all the candle-power diagrams distance out radially from the centre of the diagram to the heavy curve gives the candle-power in that particular radial direction. Thus, in the curve of horizontal distribution, if the lamp stood with axis vertical and one went around the lamp taking candle-power of

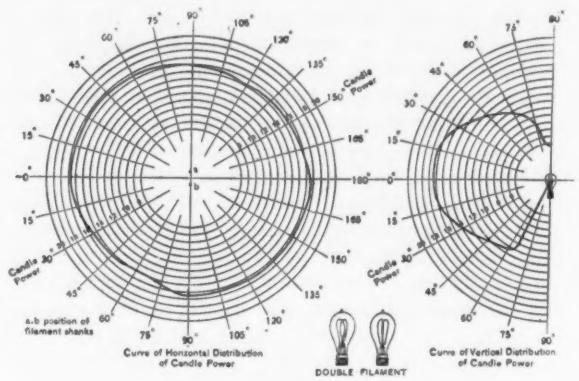

Candle Power
a-b position of filament shanks
Curve of Horizontal Distribution of Candle Power
DOUBLE FILAMENT
Curve of Vertical Distribution of Candle Power

FIG. 4.

the light given in the direction toward him as he went on, these values of candle-power have been recorded and could be read off on the diagrams up to the heavy line. The same interpretation holds for the curves of vertical candle-power at the right of the figures.

All the lamps were kept at the voltage at which they give 16 candle-power on the basis of the manufacturer's rating. In the curves of horizontal distribution they saw that lamp No. 1 with the straight U-shaped filament is quite uniform in candle-power all around. The candle-power distribution of the long curl anchored filament (lamp No. 3) and the double filament (lamp No. 4) were somewhat similar. The irregularity of the curves for lamps with coil filaments was seen from the curve for lamp No. 5. Such irregularity is common for coil filament lamps. But by far the most important distribution is that in a vertical plane. Here the great differences in candle-power procured from various filament forms showed best. The curves of lamps Nos. 1, 3 and 4 were dreadfully deficient in light from the tipped end, and the candle-power of each falls off very rapidly as the 90 degs. angle is approached. This is especially true of lamp No. 4, which, just as one comes to the direction from which the light is most important (between 75 degs. and 90 degs. at the tipped end), drops the candle-power down to less than 5 units.

The curves of vertical distribution show us that a 16-cp lamp is not one which gives 16 candle-power in the direction in which the light is wanted. A few words as to how incandescent lamps came to have their candle-power measured, as it will not be amiss here.

When incandescent lamps first became commercial they were put into competition with gas lights and were made so they would measure 16 candle-power when placed in a photometer as gas lights were placed, with a plane through the shanks of the old U-shaped filament perpendicular to the photometer bar. At the time of the Electrical Exposition in Philadelphia, in 1885, the Franklin Institute adopted an empirical or arbitrary method of measuring the mean spherical candle-power in connection with the most elaborate tests of incandescent lamps ever made in this country, which has been adopted in scientific measurements ever since; but never has been used by lamp manufacturers. Between forty and fifty candle-power readings have to be taken on each lamp, and the average of thirty-eight taken, at least two hours' time of two skilled observers being required to make the measurement of mean spherical candle-power on a single lamp. In recent years the manufacturers have rated their lamps by their mean horizontal candle-power. To save time the lamps are stood base down and rotated on a vertical axis when the candle-power measurement is made. One hundred and eighty r. p. m is a common speed, and the voltage marked on the label is that required to give 16 candle-power when the lamp is so rotating. The National Electric Light Association, through a committee appointed to investigate the matter of candle-power measurement, reported in June, 1897, that lamps can only be fairly rated upon their mean spherical candle-power, and recommended that the axis of the lamp be inclined, while rotating, at an angle of 45 degs. toward the photometer bar, and by a single reading a value read approximating the mean spherical candle-power. Various speeds of rotation from 120 to 250 r. p. m. have been suggested. In spite of the adoption of the report, manufacturers continue to rate their lamps by a measurement of mean horizontal candle-power.

CANDLE-POWER TAKEN.	CANDLE-POWER.				
	Single U-shaped Filament.	Single Curl Filament.	Long Curl Anchored Filament.	Double Filament.	Double Coil Filament.
(*a*) At 180 revs. with axis vertical	16	16	16	16	16
(*b*) Mean horizontal (standard method)	15.8	16.2	16.6	16.0	15.72
(*c*) Mean horizontal (from plotted values....	16.0	16.7	16.7	16.1	15.6
(*d*) Mean spherical (standard method)	12.7	13.5	13.75	13.2	13.8
(*e*) Mean with axis at 45°	10.5	12.0	11.7	12.0	14.0
(*f*) Mean hemispherical	14.3	14.5	14.6	14.0	14.05
(*g*) Mean within 30° from tip..	8.7	10 3	8.7	7.9	10.9
(*h*) From the tip..	5.7	8.35	7.05	4.8	10.1

FIG. 6.—CANDLE-POWER OF LAMPS WITH DIFFERENT FORMS OF FILAMENTS.

In Fig. 6 are set down a number of candle-power values for each of the five lamps representing the different filament types. Each gives a value of candle-power by which the lamp might be called. Values in line *a* were first determined. Then those in line *b* by averaging twelve separate readings taken when the lamp was not rotating and in the standard way. Values in line *c* are computed from the curves and give the true average horizontal candle-power. Line *d* is computed by the Franklin Institute method. Line *e* is the candle-power the lamps should have been marked if rated by the National Electric Light Association's standard. Lines *f* and *g* are set down for comparison, and line *h* gives the useful light.

A backward look and a little thought shows clearly that all candle-power measurements for incandescent lamps have grown out of methods which apply to the measurement of the candle-power of gas. The fact that the useful light an incandescent lamp gives is utterly different in the very nature of things from that given by a gas burner is overlooked entirely. The rational method of measuring the candle-power of an incandescent lamp is looking in at the end. This is the candle-power by which a lamp should be rated. Not only is such a method rational, but the apparatus required to make the measurement would be very simple. Until this is really done by

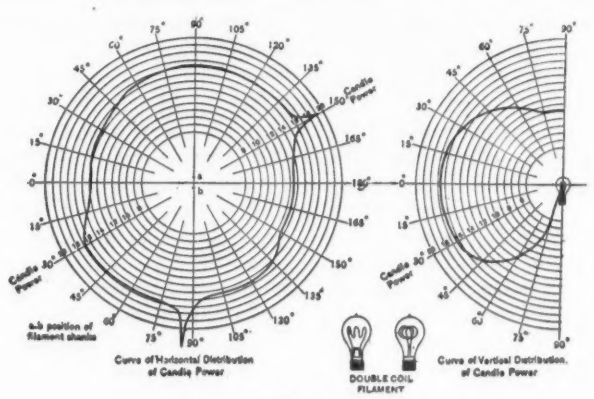

Candle Power
a-b position of filament shanks
Curve of Horizontal Distribution of Candle Power
DOUBLE COIL FILAMENT
Curve of Vertical Distribution of Candle Power

FIG. 5.

lamp makers, lamp users should always, in addition to a measurement of candle-power in the conventional way to check up lamps purchased, take a reading of the useful light out from the tip.

The efficiency of a lamp has no direct bearing on the candle-power or distribution of candle-power. It does, however, depend absolutely on the candle-power rating of a lamp and how this is taken. In Fig. 7 is given a table which shows this dependence and how terribly inefficient are most filament forms, even though they are rated at 3.5 watts per candle-power by the manufacturer, when rated on

the useful light they give. That lamp is obviously most economical to use which gives its useful light at the highest efficiency.

Watts Based on Candle-Power, as Stated.	Watts per Candle-Power.				
	Single U-shaped Filament.	Single Curl Filament.	Long Curl Anchored Filament.	Double Filament.	Double Coil Filament.
(*k*) At 180 revs. with axis vertical	3.5	3.5	3.5	3.5	3.5
(*l*) Mean horizontal (standard method)	3.54	3.45	3.37	3.50	3.56
(*m*) Mean with axis at 45°	5.33	4.66	4.79	4.66	4.00
(*n*) Mean spherical.	4.40	4.15	4.07	4.23	4.07
(*o*) Mean hemispherical	3.92	3.86	3.83	4.00	3.86
(*p*) Mean within 30° of tip....	6.44	5.44	6.44	7.09	5.14
(*q*) From the tip...	9.82	6.71	7.95	11.70	5.54

FIG. 7.—WATTS PER CANDLE-POWER OF 16-CP INCANDESCENT LAMPS ON BASIS OF DIFFERENT CANDLE-POWER RATINGS.

Prof. Rowland adds to his paper the following: Since writing the above, a new filament has been produced, designed expressly to produce a high candle-power in the vertical direction or out from the tip of the lamp. The Shelby filament is a good deal like the old double-coil filament, but the circular coils are flattened vertically, so that a much greated projected length of filament shows from the end. The bulb is also much flatter at the end than other standard forms. Lamps that I have tested, when giving a mean horizontal candle-power of 16, had a vertical (or useful light) candle-power of 14½ and a mean spherical candle-power of 15½. The efficiency on the horizontal rating was 3.7, and that on the vertical was only 4.1. Compared with the values of Figs. 6 and 7, this is a wonderful lamp. I cannot but feel that a new era in incandescent lighting has dawned when such a lamp is made, and that the importance of new methods of rating incandescent lamps for candle-power and efficiency will soon be recognized everywhere.

Grounds on Fire and Police Wires.

At the recent meeting of the Municipal Electricians at Pittsburg, Mr. Morris W. Mead presented a brief paper on the use of the ground in fire alarm telegraphy, under the later conditions of heavy trolley and electric light currents. In the course of his remarks he said:

One of the principal uses of a permanent ground connection at all signal boxes was to protect the box from lightning discharges, but the system now in general vogue of having fuse protection on all circuits, and grounded bars or plates at headquarters, it seems to me furnishes satisfactory protection in that particular respect, and therefore a ground wire lightning arrester is not really necessary to protect the system at such points, as was the case in former times when fuses were not so generally used as now.

Investigation on my part has led me to believe that very serious trouble has very frequently been introduced into fire and police telegraph circuits because of ground wires permanently connected at box points, and the trouble introduced into the system because of leakages from trolley or other heavy current, or escapes existing in water or gas mains, and in that way brought into the system, has caused very serious harm.

I am told that upon several occasions fire-alarm circuits have been found supplied with considerable current in that way, although entirely disconnected from the battery operating such circuits, and undoubtedly this outside current has been brought into the circuits through the ground connection at the box points. This illustrates only one of the dangers occurring from such methods of construction. Another serious harm likely to ensue from these permanent ground connections is caused by heavy current wires coming in contact with fire and police wires, and owing to faulty causes at the ground plate in the signal box, grounds or partial grounds have been left, and serious burn-outs have occurred on that account to the system in use in such places. It is quite difficult to keep the spark gap space thoroughly well insulated between the ground plate and the main line terminals on the lightning arrester used, and in that way frequently harm has been caused. I understand that quite a number of fire-alarm superintendents have given this matter very careful consideration, and have very much improved the security of their respective systems in adopting the plan suggested herein, and that since this plan has been used, troubles that heretofore were of frequent occurrence have been entirely removed.

Elements of Illumination—XII.

BY DR. LOUIS BELL.

THE MATERIALS OF ILLUMINATION—ILLUMINANTS OF COMBUSTION.

AT root, all illuminants are composed of solid particles usually of carbon, brought to vivid incandescence. We may, however, divide them into two broad classes according as the incandescent particles are heated by their own combustion or by extraneous means. The first class, therefore, may be stated as composed of luminous flames, such as candles, lamps, ordinary gas flames and the like, while the second consists of illuminants in which a solid is rendered incandescent, it is true, but not in virtue of its own combustion. The second class thus consists of such illuminants as mantle gas burners, electric incandescent lamps and the electric arcs, which really give their light in virtue of the intense heating of the tips of the carbons by the arc which in itself is relatively of feeble luminosity.

Illumination based on incandescent gas, phosphorescence and the like, is in a very early experimental stage, and while it is in this direction that we must look for increased efficiency in illumination, nothing of practical moment has yet been accomplished. To the examination of flame illuminants, then, we must first address ourselves.

They are interesting as being the earliest sources of artificial light,

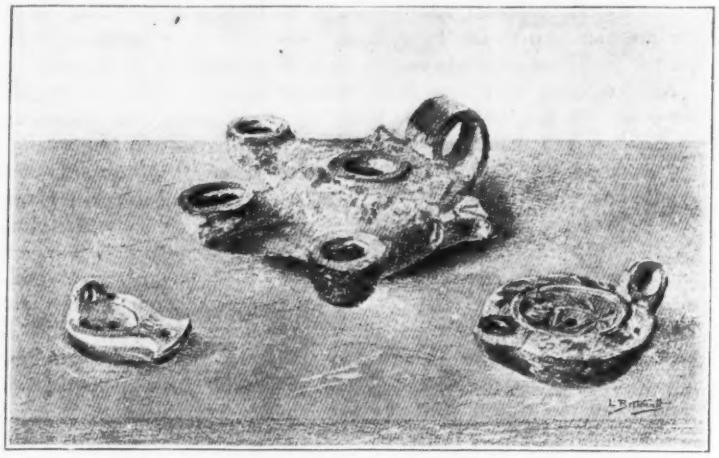


FIG. 1.—EARLY ROMAN POTTERY LAMPS.

and while of much less luminous efficiency than the second class referred to, still hold their own in point of convenience, portability and ease of extreme sub-division.

We have no means of knowing the earliest sources of artificial light as distinguished from heat. The torch of fat wood was a natural development from the fire on the hearth. But even in Homeric times there is clear evidence of fire in braziers for the purpose of lighting, and frequent mention of torches. The rope link saturated with pitch or bitumen was a natural growth from the pine wood torch, later elaborated into the candle.

It is clear that both lamps and candles date far back into prehistoric times, the lamp being perhaps a little the earlier of the two. At the very dawn of incipient civilization man had acquired the idea of soaking up animal or vegetable fats into a porous wick and so burning it, and the use of soft fats probably preceded the use of those hard enough to form candles conveniently. The early lamp took the form of a small covered basin or jar with one or more apertures for the wick and a separate aperture for filling. They were made of metal or pottery, and by Roman times had come to be often highly ornamented. Fig. 1 shows a group of early Roman lamps of common pottery, which gives a clear idea of what they were. They rarely held more than one or two gills, and must have given at best but a flickering and smoky light. Fig. 2 shows a later Roman lamp of fine workmanship in bronze.

In early times almost any fatty substance that would burn was utilized for light, but in recent centuries the cruder fats have gone largely out of use, and new substances have been added to the list. It would be a thankless task to tabulate the properties of all the substances which have been burned as illuminants, but those in practical

use within the century just passed may for convenience be classified about as follows:

FLAME ILLUMINANTS.

Fats and Waxes.—Tallow (stearin).
Sperm oil.
Spermaceti.
Lard oil.
Olive oil.
Whale oil.
Beeswax.
Vegetable waxes.

The true fats are chemically glycerides, i. e., combinations of glycerin with the so-called fatty acids, mainly stearic, oleic and palmetic. The waxes are combinations of allied acids with bases somewhat akin to glycerin, but far more complicated. Technically spermaceti is allied to the waxes, while many of the vegetable waxes properly belong to the fats.

All these substances, solid or liquid, animal or vegetable, are very rich in carbon. They are composed entirely of carbon, hydrogen and oxygen, and as a class have about the following percentage composition by weight: Carbon, 76 to 82 per cent; hydrogen, 11 to 13 per cent; oxygen, 5 to 10 per cent. They are all natural substances which merely require to go through a process of separation from foreign

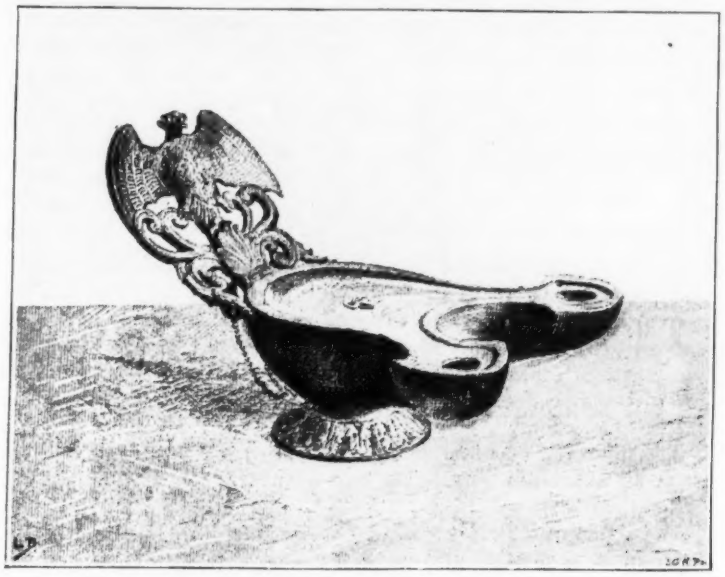


FIG 2.—LATER ROMAN LAMP OF FINE WORKMANSHIP.

matter, and sometimes bleaching, to be rendered fit for use. An exception may be made in favor of "stearin," which is obtained by breaking up chemically the glycerides of animal fats and separating the fatty acids before mentioned from the glycerin. The oleic acid, in which liquid fats are rich, is also gotten rid of in the commercial preparation of stearin.

In a separate class stand the artificial "burning fluids" used considerably toward the middle of the century. As they are entirely out of use, they scarcely deserve particular classification. Their base was usually a mixture of wood alcohol and turpentine in varying proportions. From its great volatility such a compound acted almost like a gas generator; the flame given off was quite steady and brilliant with much less tendency to smoke than the natural oils, but the "burning fluids" as a class were outrageously dangerous to use, and fortunately were driven out by the advent of petroleum and its products.

Petroleum, which occurs in one form or another at many places on the earth's surface, has been known for many centuries, although not in large amounts until recently. Bitumen is often mentioned by Herodotus and other early writers, and in Pliny's time mineral oil from agrigentum was even used in lamps.

But the actual use of petroleum products as illuminants on a large scale dates from a little prior to 1860, when the American and Russian fields were developed with a common impulse. Crude petroleum is an evil smelling liquid, varying in color from very pale yellow to almost black, and in specific gravity from 0.77 to 1.00, ranging commonly from 0.80 to 0.90. Chemically it is composed essentially of carbon and hydrogen, its average percentage composition being about: carbon, 85 per cent; hydrogen, 15 per cent. It is composed in particular of a mixture of the so-called paraffin hydrocarbons, having the general formula $C_n H_{2n+2}$ and the members of this series found in ordinary American petroleum vary from methane CH_4 to penta decane $C_{15}H_{32}$, and beyond to solid hydrocarbons still more complicated.

To fit petroleum for use as an illuminant, these component parts have to be sorted out, so that the oil for burning shall neither be so volatile as to have a dangerously low flashing point or so high as not to burn clearly and freely. This is done by fractional distillation. The following table gives a general idea of the products arranged according to their densities:

	Substance.	Density.	Use.
Petroleum ether.	Cymogene,	0.59	Small.
	Rhigoline,	0.63	
	Gasoline,	0.65	Gas, explosion engines
Petroleum spirit.	Benzine naphtha,	0.68	Gas lamps, engines.
	Naphtha,	0.71	Cleaning, engines.
	Benzine,	0.74	Varnish, etc.
Kerosene.....	Kerosene of various grades,	0.78 to 0.81	Illumination.
Oils.....	Lubricating oils of various grades.	0.87 to 0.93	Lubrication.
Solids.....	Vaseline,		Emollient.
	Paraffin,		Candles, insulation, waterproofing, etc.

"Petroleum ether" and "petroleum spirit" find little use in illumination, for they are so inflammable as to be highly dangerous, and form violently explosive mixtures with air at the ordinary temperatures. Kerosene should be colorless, without a very penetrating odor, which indicates too great volatility, and should not give off inflammable vapor below a temperature of 120 degs. F., or, better still, below 140 degs. F. to 150 degs. F. Oils of the latter grades are pretty safe to use, and are always to be preferred. The yield of kerosene from crude oil varies from place to place, but with good American oil runs as high as 50 to 75 per cent.

Paraffin is used unmixed for making candles, but is preferably mixed with other substances like stearin to give it a higher melting point.

Having thus looked over the materials burned in candles and lamps, the results may properly be considered.

Candles.—These are made usually of stearin, paraffin wax or mixtures of the two first named. They are molded hot in automatic machines, and, as usually supplied in this country, are made in weights of 4, 6 and 12 to the pound. Spermaceti candles are also made, but little used except for a standard. The English standard candle is of spermaceti, weighing one-sixth of a pound and burning at the rate of 120 grains per hour. Commercial candles give approximately one candle-power, and burn generally from 110 to 130 grains per hour. As candles average from 15 to 18 cents per pound, the cost of one candle-hour from this source amounts to about 0.25 cent to 0.30 cent. This is obviously very expensive relatively, although it must not be forgotten that candles sub-divide the light so effectively that for many purposes 16 lighted candles are very much more effective in producing illumination than a gas flame or incandescent lamp of 16 candle-power. The present function of candles in illumination is confined to their use as portable lights, for which, on the score of safety, they are far preferable to kerosene lamps, and to cases in which, for artistic purposes, thorough sub-division of the light is desirable. Where only a small amount of general light is needed, candles give a most pleasing effect and are, moreover, cleanly and odorless. In efficiency candles leave much to be desired. For, taking the ordinary stearin candle as a type, it requires in dynamical units 90 watts per candle-power, consumes per hour the oxygen contained in 4.5 cu. ft. of air and gives off about 0.6 cu. ft. of carbonic anhydride. In these respects the candle is inferior to the ordinary lamp and still more inferior to gas or electric lights. Nevertheless, it is oftentimes a most convenient illuminant.

Wireless Telegraphy.

A cable dispatch from London of Oct. 6 says: "Marconi to-day successfully transmitted a message by the wireless system from Boulogne, France, to Dovercourt, a distance of 60 miles. The customary mode of receiving and transmitting the message on poles was abandoned at to-day's test, the dispatch being received on a cylinder only 4 ft in height."

A Method for Measuring the Slip of Induction Motors.

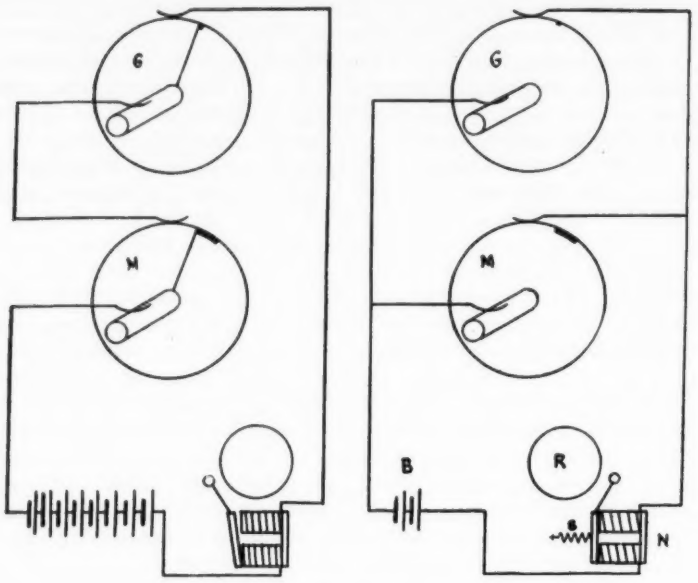
BY W. HAND BROWNE, JR.

THE usual method of measuring the slip of an induction motor by taking the speed of both generator and motor with revolution counters, reducing the speed of the generator to the corresponding speed for a machine having the same number of poles as the motor, and then assuming the difference to be the slip of the motor, is open to serious objections. The method itself is a crude one, consisting, as it does, in an attempt to determine a comparatively small quantity by measuring two large ones. Two readings must be made simultaneously instead of one, and an error in either will cause a much larger error in the result. Thus an error of one-half per cent in the speed reading of a 4-pole, 60-cycle machine would be 9 revolutions. If the actual slip of the motor, running loaded, were 5 per cent, or 90 revolutions, the above error would cause an error of 10 per cent in the slip determination. At light loads, when the actual slip is usually less than 1 per cent, this error would be over 50 per cent, and the determinations would be valueless.

The method used by Messrs. Siemens & Halske* is a decided improvement over the old. They employ two separate counters on generator and motor, with electromagnetic attachments for throwing them in and out of gear simultaneously when the observer presses a key. The apparatus used is somewhat elaborate, and the method, though accurate, is also open to the first objection given above—the slip is not measured directly.

Stroboscopic methods† have been used, but these throw additional work on the eye, which usually is already fully employed.

When the secondary of the motor has independent coil windings



FIGS. 1 AND 2.

the slip may be determined by measuring the frequency of the induced current.‡

The following method in which the slip is measured directly seems to the writer to be free from all the objections mentioned above.

Two revolving contact makers are attached, one to the motor shaft and one to the generator shaft (or to a synchronous motor having the same number of poles as the induction motor and driven from the same circuit). The contact maker on the generator makes contact once for each revolution of the motor if driven at synchronous speed. That on the motor makes contact for each actual revolution of the motor. The two instruments are connected in series (see Fig. 1) in circuit with a single-stroke bell and battery.

The action is as follows: Let the two contact makers be in such position that contact is made by both at the same instant. The current will be completed and the bell will strike. Let the motor slip be exactly 2 per cent, then when the generator has made one revolution the motor will have fallen back 2 per cent, and the two breaks in the circuit will not be closed at the same instant. Consequently, the bell will not ring. When, however, the generator has made 50 revolutions the motor will have made exactly 49; the two contacts will pass under the brushes at the same instant, completing the circuit, and the bell will ring again, indicating one revolution slip.

If the slip be something more or less than a whole number of revolutions, the two contact strips will come into phase at some point of the revolution not under the brushes, and may be out of phase again when passing under the brushes, failing to ring the bell. Suppose the maximum slip of the motor is 5 per cent, and let the contact strip on the motor contact maker be a little more than 5 per cent of the circumference: Since the motor loses at the most one-twentieth of a revolution while the generator makes one complete revolution, it will take a little more than one revolution of the generator for its contact strip to pass that on the motor, and the bell will always ring when the motor has lost one revolution. If the actual slip is 1 per cent, the circuit will be completed once in each revolution for five consecutive revolutions before the strips are far enough apart not to make contact at the same time. There will then be a pause during 95 revolutions, and then four or five more rapid strokes. If the slip is 2 per cent, there will be two or three strokes close together every 50 revolutions, each group indicating one revolution slip.

In order to measure the slip, find, with a stop-watch, the time during which the motor loses some convenient number of revolutions. The time measured from the first stroke or group of strokes to the 21st, will be that during which the motor loses 20 revolutions. Let this be 40 seconds. If the motor be a 4-pole, 60-cycle machine, the synchronous speed will be 30 revolutions per second.

The slip will then be given in revolutions by

$$\frac{20}{40} \times 60 = 30;$$

and in per cent by

$$\frac{20}{40} \times \frac{1}{30} = 1.6\%.$$

In applying this method one or two difficulties were encountered. The time of contact was so short that a fairly high potential was required to overcome the self-induction and establish a current strong enough to ring the bell. Moreover, when the circuit was broken at the generator contact, as usually happened, this being the short strip, the sparking produced was found to be disastrous and the ringing of the bell uncertain.

The following modification was, therefore tried and found to overcome all difficulties, ringing the bell with certainty and needing but little attention.

The action of the contact makers is reversed—that is, they are constructed so as to break the circuit during a short period only of the revolution. They are connected in parallel, and the bell arranged so as to ring by the action of the spring when the circuit is broken. The action is analogous to that described above. Now, however, the bell rings only when the circuit is open simultaneously at both contact makers. To insure a ring every time one revolution is lost, the break in one contact maker must be, in per cent of the circumference, somewhat greater than the maximum slip which is to be measured.

The following diagram (Fig. 2) will make the application of this method clear:

G is the contact maker on the generator, or on the synchronous motor shaft, making a short break;

M is the contact maker on the motor shaft, making a long break;

N is the magnet which normally holds the clapper against the pull of the spring away from the bell *R*, releasing it only when the current is broken;

B is the battery, two dry cells being sufficient.

With this arrangement, burning at the contact makers due to sparking can have no effect. The action of the spring is certain. The contact makers required are simple, as a piece of copper with a small segment cut out, fastened on a disc of wood, is sufficient.

This method has been used constantly during the past year at the Electrical Engineering Laboratory of the University of Illinois, and has been found entirely satisfactory and reliable.

*Elektrotechnische Zeitschrift, Nov. 2, 1899. †*Science* Abstracts, October, 1899, No. 1570, by M. Horr; (b) *Electrical Review* (Lond.), Jan. 5, 1900, by Dr. G. Benischke. ‡See (a) above.

Wireless in Chili.

The Wireless Telegraph & Signal Company, Limited, of England, has been authorized by the Chilian Government to establish telegrahic communication by means of the Marconi system between Punta Arenas and Ancud or Puerto Montt. By the terms of the concession the company is granted the right to use public lands.

High Speed Electric Elevators.

At the meeting of the Chicago Electrical Association Oct. 5 Mr. Hayward Cochrane, electrical engineer of the Eaton-Prince Company, read a paper on "Electric Elevators for Safe and Economical Operation at High Speeds." The author introduced the subject with a brief statement of the usual requirements for electric elevator controllers. The full speed should be attained in from 5 to 8 seconds and the acceleration should be smooth, without jerk or jump of the car. The rush of current should be as small as possible consistent with the acceleration, to permit incandescent lighting on the same circuit. The controller should be adaptable to either cable or lever device, and contacts should not be injured by sparking, to insure long life. The earlier electric elevators were operated by a plain shunt motor. Such a motor called for high starting current. To reduce this and at the same time get high starting torque, motors with compound winding have been adopted, with series coils assisting shunt coils, and the series coils always in circuit. Later designs cut out the series turns after the motor was up to speed. By this means a very small starting current was obtained together with a fairly good full speed running efficiency. With worm-geared winding machines, experience has shown that with a gearing of low ratio and high efficiency there is a tendency for the load to drive the motor as a generator under certain conditions. With winding drum elevators it has been good practice to counterweight the car to an amount equal to about half the loaded weight of the car. If the gearing is efficient enough the counterweight may drive the motor as a generator when the car is going up with no load, or if the car is going down with very heavy load and small counterweight the same thing may occur. If the series winding of the motor in such a case happens to be cut out of circuit the armature will run up to a high speed before its e. m. f. will balance that of the line; or if the series coils are in circuit the motor acting as a generator will reverse the series coils and weaken the fields so as to cause a runaway. It is desirable to design the controller so that it will automatically weaken the field irrespective of the position of the operating handle whenever the load drives the motor. It is also desirable to be be able to run at varying speeds at will according to the position of the operating device, no matter what the load is. By means of an automatic commutating device, which the author described in detail in connection with a compound elevator motor controller, these advantages are obtained. He also described an electrical method of control in connection with the commutating device. He took up briefly the traveling nut and multiple sheave machine, which, he said, gives practically the same speeds and kinds of service as the hydraulic machine, but the motor for the same service must be larger than that for a winding drum worm-gear machine, making the first cost high. The multiple sheave type requires a light counterweight to insure descent of the car, making a heavy dead load to be lifted compared with a heavily counterweighted elevator. Some energy is put back into the line at times by the winding drum machines but not by the traveling nut machines. The pilot motor and electric brake of the latter require considerable energy. The new differential type of elevator was also described. In this, two motors running constantly are employed and the speed of the elevator is dependent on the difference in speed of the two motors. This type was criticized unfavorably because of the large motor capacity required and the rapid wear of the cables in passing over the necessarily small pulleys on the motors, the difficulty in making satisfactory splices in the cables and difficulty of keeping even tension on the cables, and the inefficiency of the slow speed motors that must be used. Experience has shown that there is a difference of $5 to $15 a month in cost of operating an elevator with electrically released brake as compared to mechanical release. This is taken from meter readings. The conclusion reached by the author was that the winding drum elevator mechanism when properly constructed ought to fulfill all reasonable requirements for high speed service and at a decided economy over any other known form of elevator mechanism. In the discussion following, Mr. F. S. Hickok gave the speed of the fastest electric elevators three years ago as 200 ft. per minute. This six months later was increased to 350 ft. per minute. Recently the double-motor differential equipment in Chicago has made 400 ft. per minute. Hydraulic practice is somewhat faster than this. Mr. Cochrane, in answer to questions, said that he was familiar with a high-speed winding drum and worm-gear passenger elevator machine which showed on actual test an efficiency of 60 to 68 per cent, calculated from the watt hours at the motor terminals and the foot pounds lifted on the car.

Data on Electrical Fish.

At the recent meeting of the British Association for the Advancement of Science, Prof. F. Gotch, F.R.S., delivered a lecture on "Animal Electricity," in which he gave many interesting details as to electrical fish. He said that every electrical organ in such fish was built up of columns containing a vast number of special structures arranged in series. The features were so distinctive that an electrical organ was as readily identified by its anatomical structure as a muscle was by the form of its muscular fibres. The organ column, he said, had its physical analogy in the voltaic pile. Where there were thousands of these elements in series, the total electrical effect became very considerable. The gymnotus electrical eel of South America had thousands; the malapterurus, the fresh water fish of North Africa, has tens of thousands; these fish, therefore, illustrating the familiar saying that there is force in numbers. The malapterurus was particularly astounding in this respect; the organ was in the skin and contained at least 3,000,000 disks; about 5000 being arranged one after another, and this was repeated 600 times. "The astonishing thing is," said he, "that whereas each of these disks is the receptacle for a nerve ending, each half of the whole organ with 1,500,000 disks receives all its nerve branches from one nerve fibre, the process of one giant nerve cell. The shock of the fish is of extraordinary intensity, but this is due to the number of individual elements concerned in the production of the electrical disturbance." Here he exhibited a living specimen lent for the purpose by the Liverpool Corporation Museum, and experiments were made to show that the shock of the fish could affect the mercurial column of a capillary electrometer, and that in this way photographed records of the shock could be obtained. Such photographic records showed that each shock is multiple; the electrical organ, once it has been made to produce its shock, will go on doing so automatically. The power of each blow—in other words, its electromotive force—was astounding. In a fish about eight inches long he had determined that under unfavorable conditions the first electrical disturbance could reach a maximum of 200 volts.

Prof. Jno. Perry, president of the Institution of Electrical Engineers, said his section of Philistines looked upon the study which Prof. Gotch had entered upon as of the greatest importance to engineers. The best marine engines only yielded for every shillingworth of coal one pennyworth of energy, eleven pennyworth being wasted. Ordinary engines returned but one penny in 230 pence, a waste of 19s. 11d. Wastage was inherent in heat engines, but electromagnetic engines would be practically without waste, and would return 98 per cent of the energy of the fuel consumed. For years some of them had been working to burn fuel electromagnetically, and had succeeded in a clumsy, imperfect, expensive way. If the governments of the world would only expend 20 or 30 millions on the task it would pay in the long run. Some one sometime would succeed, but by that time the coal measures of the world would be exhausted. The electro-biological people were on the right track, and if they pursued it long enough they would ultimately show engineers how to build the ideal engine.

Automobiles in the Army.

In his annual report to the Secretary of War, Lieut.-Gen. Miles, U. S. A., will renew his recommendation for the further use of the automobile in the army. According to a Washington despatch, there are now at Fort Myer, Va., three automobiles, but they have not proved quite satisfactory, on account of lack of facilities for recharging them with electricity. Meanwhile General Miles and other officers interested in making the automobile useful for the army have been making investigations of other powers than electricity with a view of obtaining a practical method of making the machine available for military purposes.

Mustard Plaster Electricity.

It is stated from Seneca Falls, N. Y., that people in that vicinity have been imposed on during the past month by a slick stranger who had what he called an electric belt, which was guaranteed to cure any number of diseases. Those who wore it said that they could feel a burning sensation, but that they did not get the promised relief. Finally one belt was dissected, when it was found that the "electricity" was generated from a strip of mustard plaster under a covering of thin cloth. It is not known how many were taken in by this slick individual, as people as a general thing do not like to own up to being fooled, but it is believed he did a good business.

On the Similarity of Effect of Electrical Stimulus on Inorganic and Living Substances.*

BY JAGADIS CHUNDER BOSE, M.A., D.Sc.,

PROFESSOR OF PHYSICAL SCIENCE, PRESIDENCY COLLEGE, CALCUTTA.

If we take a piece of living tissue, say a piece of muscle, and subject it to an electric stimulus, there will be produced a contraction; the stimulus causes a molecular rearrangement by which the form of muscle is changed. On the cessation of stimulus the muscle, recovering from the molecular strain, gradually attains its original shape. The effect of stimulus on nerves is, however, not apparent; there is no change of form. The molecular disturbance due to stimulus can, nevertheless, be detected in an indirect manner from certain electromotive variations that are produced. If now a mass of metallic filings be taken and subjected to electric shocks there is no visible change. The substance appears to be irresponsive or dead to stimulus. Are inorganic substances then really irresponsive? Could this apparent want of response not be due after all to our inability to detect the profound molecular changes that may have nevertheless taken place in the substance under the action of stimulus? In nerves it is seen that the molecular changes can only be detected indirectly by an electric method.

The author describes an electric method based on the variation of conductivity, by which the molecular change due to an electric stimulus in an inorganic substance is detected and measured. Curves are in this manner obtained with the conductivity variation (proportional to molecular effect) as ordinates, and the time of exposure to the stimulus or the time of recovery from the effect of stimulus as abscissæ.

It is next shown that the effect on matter of electric stimulus of widely varying frequencies is a continuous one. There is also a continuity of effect on all forms of inorganic matter, similar effects being produced not only (1) in all elementary substances—metals, non-metals and metalloids—but also (2) in metallic compounds, such as chlorides, bromides, iodides, oxides and sulphides.

Comparisons are next made of the molecular response in both inorganic and living substances under varying conditions:

1. On the effect of moderate stimulus.
2. On the effect of maximum stimulus.
3. On the effect of superposition of medium stimuli—(*a*) effect due to slow intermittence; (*b*) tetanic effect due to rapid intermittence.
4. On the opposite effect due to strong and feeble stimulus.
5. On the transitory negative effect.
6. On the physical theory of "fatigue" in inorganic and living substances.
7. On the various means of rapidly removing fatigue.
8. On the effect of injection of various substances which act as "poisons."

In all the above cases the curves for both living and inorganic substances are found to be similar.

The author next explains a theory of vision, and describes an artificial retina; the various effects of radiation on this artificial retina explain many obscure phenomena of vision.

Parallel experiments are then described with the artificial and real retina:

1. On the effect of short exposure to the action of radiation.
2. On the effect of intermittent radiation; on the question of the presence or absence of "flicker" depending on the intensity of radiation and on the rapidity of intermittence.
3. On the peculiarity of the visual sensation curve, as explained by the curve of effect on the artificial retina.
4. On the different elements of retinal fatigue.
5. On certain curious reversal effects.
6. On after-oscillation and visual recurrence.
7. On the novel phenomenon of binocular alternation of vision, and on the analysis of superposed images by alternate after-vision.
8. On the persistence of retinal oscillation, and its continuity with the phenomenon of memory.

In all the phenomena described above there is seen an identity of effect of external stimulus on both living and non-living forms of matter. It is difficult to draw a line and say "here the physical process ends and the physiological process begins," or "these are the lines of demarcation that separate the physical, the physiological, and the beginning of psychical processes." No such arbitrary lines can be drawn, there being no breach of continuity.

*Abstract of paper read at the British Association meeting, Bradford.

Combined Telephone Relay and Repeater.

A patent has been issued to Mr. E. C. Paramore, of Philadelphia, on a combined relay and repeater for use on long-distance telephone lines. Fig. 1 is a diagram of two telephone lines showing the combined relay and repeater at the junction. Fig. 2 is a side view. Fig. 3 is a vertical section through one of the relay transmitters. In Fig. 2, the numeral 1 designates a base or support. Secured to this are four brackets 2, each comprising upright arms 3 and a right-angled foot 4, the latter being secured to the base 1. These brackets are arranged in pairs at the ends of the base, and secured to the upright arms 3 of each pair of brackets is a relay transmitter 5. Secured to the upright arms 3 of two of the aligned brackets 2 is a ring or an-

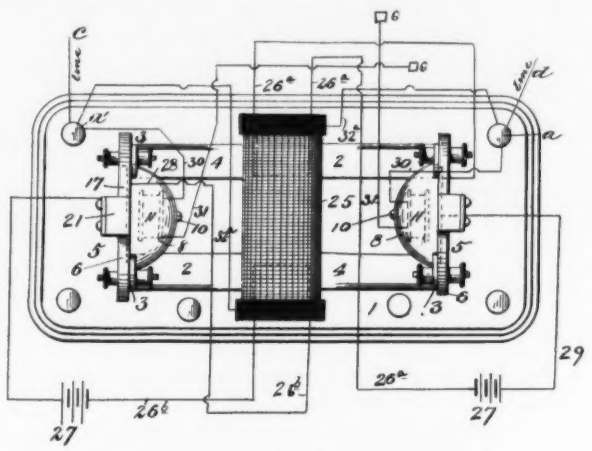
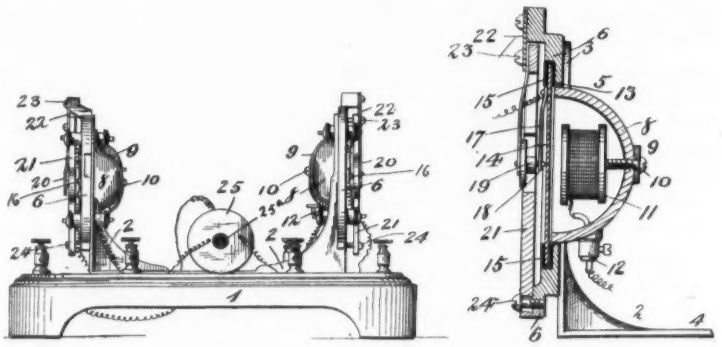


FIG. 1.

nulus 6. The bolts or screws 7, four in number, hold the ring 6 firmly to said arms 3. A dome 8 is secured within the ring 6 by suitable means, such as a metallic strip or band 9, secured centrally to the dome by a screw 10 and at the ends of the strip by the bolts 7.

The screw 10 passes into the dome and serves as a support for an electromagnet 11, the terminals from which pass through binding tubes 12 12 at the bottom of the dome, and thence one of the terminals is connected to one line circuit and one to ground. The ring 6 is rabbeted at 13, and within the recess thus formed the diaphragm 14 is seated. A rubber gasket 15 covers the edge of the diaphragm, which is held in place by two or more turn buttons or keepers 16, attached at their outer ends to the ring 6.

A slender spring 17, attached at the upper edge of the diaphragm, extends to its centre and is provided with a pointed electrode 18, which bears against the carbon button 19, secured to the end of a spring 20, the upper end of which is secured to the adjusting lever 21. This adjusting lever is connected to a spring 22 at its upper end, said spring being attached to the ring 6 by screws 23. The lower end of the adjusting lever is held in adjusted position by a set-screw 23,



FIGS. 2 AND 3.

passing through a slot in the adjusting lever and into a threaded aperture in the ring 6.

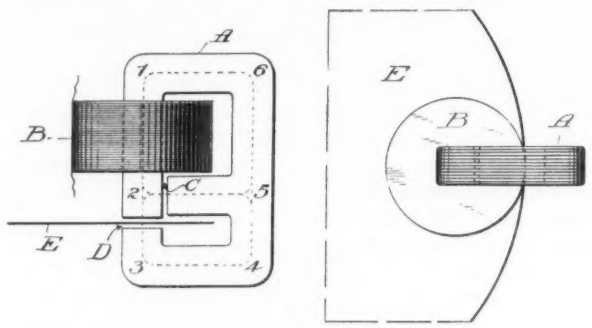
An induction coil 25 is secured to the base 1 between the transmitters 5. This coil 25 is supplied with three windings—two primaries 26, wound one on top of the other in order to bring them as close as possible to the magnetic core 25^a, and a secondary 32, wound on top of the two primaries. The extremes of the two primaries are connected up to wires 26^a and 26^b, respectively, which are connected in turn to the batteries 27 and the microphones on the repeaters 5.

The extremes of the secondary 32 are connected to wires 32a, which are oppositely connected to the main-line wires, one through the binding post *a* to the line *d* and the other through the binding post *a'* to the line *c*. The main lines, as shown, are grounded at both ends. When the transmitter on line *d* is being used, the vibrations are directly transmitted to the repeating diaphragm 14. These are taken up by the primary of the induction coil and are intensified by the action of the battery 27 and induced in secondary 32 and transmitted to line *c* and thence to the receiver. As the apparatus is symmetrically arranged, the operation of the other repeater is obviously the same as the one just described. It is true that the current will divide at *a* and a portion go directly into the secondary and thence over the line *c*; but since the resistance of the secondary is relatively great as compared with coil 11 the interference caused by this division will be slight.

Producing Phase Displacement.

Mr. W. Stanley, of Great Barrington, Mass., has recently had issued to him a patent on producing phase displacement. The invention consists in methods and apparatus shown herewith, and the patent embraces some alternative means also.

Fig. 1 represents a side elevation of suitable apparatus. Fig. 2 shows a plan view of the same. Fig. 3 is a diagram illustrating the various forces and their resultants. In carrying out the invention Mr. Stanley employs an iron or soft-steel core *A*, laminated to prevent eddy currents in the usual manner, which core nearly embraces the energizing coil *B*, as shown in Fig. 1, in which a principal magnetic circuit follows the line 1 2 5 6, while a subsidiary magnetic circuit follows the line 1 2 3 4 5 6. The magnetic circuit is opened at *C* and *D*, and the flux is caused to pass across air-gaps at these points, each of which is of such dimensions that the paths 1 2 5 6 and 1 2 3 4 5 6 have a constant coefficient of induction and are of low magnetic reluctance. From this construction it is evident that the value of the flux found in the gaps *C* and *D* will be inversely as the reluctances of these gaps, so that by adjusting the reluctance of either the value of the flux in the one or the other may be adjusted with great exactness and that the inductance of the system, and consequently the time constant of the apparatus can be made very great by making the value of either air-gap reluctance comparatively low. The gap *C* is therefore made so small as to make the time constant very great, but not so narrow as to prevent an appreciable flux passing across the gap *D*. Such an arrangement of itself, however, is unable to give a lag to the current or magnetization of the apparatus of more than about 80 degs. to 82 degs. or 83 degs, when energized by currents of the usual frequency employed in the arts. Mr. Stanley has discovered that by inserting an electrically-closed circuited system—such, for instance, as a disk *E*, of conducting material—in the air-gap *D*, he can act upon the magnetic flux passing through said gap so as to cause the effective flux to no longer coincide with the phase of that passing through the gap *C* or the phase of the current in the coil *B*, but to be delayed by the magnetizing effect of the eddy currents induced in the disk *E*, and, further, he has noted that the phase angle of the effective or resultant flux of the gap *D* depends upon the conductivity of the inserted closed-circuited system. In constructing the apparatus to carry out the invention, therefore, so as to obtain, for instance, 90 degs. displacement, having made an electromagnetic system having an air-gap of such reluctance that the current in the energizing coil is retarded in the neighborhood of 80 degs. behind the impressed e. m. f. by the self-induction of the energizing coil, he inserts within the gap a closed-circuited conducting system of such conductivity that the currents induced therein shall set up a m. m. f.



FIGS. 1 AND 2.

which acting with the m. m. f. due to the current in the energizing coil shall produce a resultant effective flux displaced from the phase of the current in the energizing coil by the complement of its angle of lag. These forces and their resultants are diagrammatically illustrated in Fig. 3, in which *h i* represents the e. m. f of the system, and *i j* the phase angle of the current in the coil *B* and the phase angle and strength of the m. m. f. across the gap *D* due to the coil *B*; *i k* represents both the phase angle and strength of the m. m. f. due to the eddy currents in the disk *E*, and *i l* represents the resultant of the m. m. fs. *i j* and *i k*, which resultant is displaced in phase from the original m. m. f. *i j* by the angle *j i l*, which is the complement of *j i h*, the angle of lag of the current in the coil *B* making the angle of the resultant or effective flux 90 degs. from the e. m. f. of the system. It is to be noted that the magnetism threading the coil *B* is not appreciably affected by the presence of the disk *E*, the reactive effect of the current induced in the disk being substantially confined to the magnetic circuit 2 3 4 5.

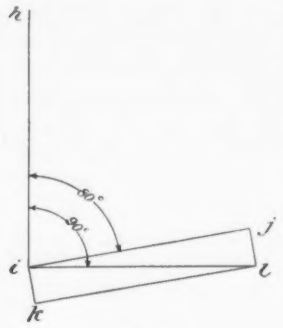


FIG. 3.

Hence the principles employed in the above-described apparatus to effect the desired result are a magnetic circuit of very high inductance having a definite air-gap, and consequently a fixed and definite time constant independent of any reactive effects occurring by reason of the use of the flux used in the apparatus, and a second path for a part of the flux having a definite air-gap, and consequently a definite time constant, in which is located a conductive circuit for the purpose of modifying the time of the flux in the path which it embraces, to the end that the common flux passing through the coil *D* may pass through two branches, one of which will be delayed in phase behind the other by the angle which, added to the angle of current lag in the energizing coil, makes the desired displacement.

CURRENT NEWS AND NOTES.

SWISS WATER POWER USE.—United States Consul Hughes, at Coburg, reports to the State Department that a company has been formed in Switzerland to work the large deposits of iron ore in the Bernese Oberland. It is intended to smelt the metal electrically, the large water power being cheaply obtainable.

A PLUCKY GIRL.—An Italian laborer at Peru, Ind., owes his life to Miss Ruth Covington, daughter of the president of the Peru Electric Light Company. The trench in which he was working caved in just as she passed. Not waiting for help, she jumped in and pulled the rocks and dirt off the man, procured whisky, restored him to his senses and bound up his wounds. Then she needed surgical aid herself.

NEW USE OF LIQUID AIR.—Consul-General Guenther writes from Frankfort, Aug. 9, 1900: "Mr. Carl Linde, who is giving special attention to machines for producing liquid air, describes, in the journal of the Association of German Engineers, a furnace designed by Mr. Hempel for an ingenious application of this substance. The furnace is intended to burn low-class fuels, such as lignite and peat. The combustion is intensified by turning the gaseous mixture obtained by evaporating liquid air on the fire. Nitrogen is first set free, after which there remains a gas containing at least 50 per cent of oxygen. The price of this gaseous mixture is said not to exceed 81 cents for 1000 cubic feet.

ELECTRICITY ON GERMAN FARMS.—Under date of Aug. 23, 1900, Consul Hughes, of Coburg, says: "In this and neighboring parts of Germany, considerable attention is being paid to electrical appliances that can be used on the farm. Near Ochsenfurt, in Bavaria, a company composed of landowners and small farmers has been organized for the establishment of an electrical system for use on their farms and in villages. The current is to be generated by steam and water and to be distributed from a central station to the places at which it is wanted. Sub-station are to be established at given points, with the necessary apparatus for connecting with the farm or other machinery, and also for lighting purposes in the houses, offices, roads and village streets."

ELECTRICAL ANTITHESES.—In New York, the foremost city in the country, some strange contrasts may be observed. In the matter of street railway transportation the most modern conduit systems run alongside of antiquated horse car lines. Another antithesis exists in one of the outlying sections, where electric lights have been replaced by oil lamps on one of the avenues.

TO PREVENT HOLD-UPS.—A correspondent informs us that a locomotive engineer of Orleans, Ind., has invented an electric arrangement by means of which a train crew can be apprised of a hold-up by train robbers. By "touching a button" a sort of Fourth-of-July action takes place. Whistles blow, the train lights go out and guns in the baggage car are fired. Such a demonstration, it is thought, will discourage the robbers in their work.

EXCHANGE QUOTATIONS.—At Milwaukee, on Oct. 1, Judge Seaman denied the petition of the Chicago Board of Trade for a temporary injunction restraining several alleged bucket shops of Milwaukee from using the quotations of the Chicago Board. The answer of the brokers, the court said, raises an issue as to whether the Board of Trade has not lost its right of property in the quotations by publication. The case has been sent to a referee.

SPEECH IS TWENTY-FIVE DOLLARS.—A special dispatch from Louisville, Ky., of Oct. 6 says: The "hello" girls here are wailing long and loud. The Cumberland Telegraph & Telephone Company, which owns all the leading lines in the South, has issued an order requiring operators to furnish a guarantee bond of $25 that they will not talk over the lines themselves. This order was made necessary by the fact that a number of operators were accustomed to use the lines for gossipping with each other and with male friends.

CAPTURING AN EAGLE.—A special dispatch from Denver, Colo., of Sept. 28, says: A huge brown mountain eagle made an attempt to carry off a small boy who was playing in the court house fountain to-day. When scarcely 30 feet from the child its broad wings and heavy body encountered the telephone wires. The bird rebounded, turned beak over talons limply, and fell with a heavy splash into the pool of the fountain. The eagle was dazed by the shock and was captured by a clerk in the county treasurer's office. Its spread was 8 ft. from tip to tip, and its weight 40 pounds.

ELECTRIC RAILWAYS IN DEMERARA.—Mr. F. P. Brothers, manager of the Demerara Electric Company, of which Sir W. Van Horne is president, has returned to Montreal from Georgetown, British Guiana, where he has been engaged in superintending the building of the electric street railway there. The company has already constructed 12 miles of electric railway, and it is expected that the line will be in operation by Oct. 10. The Demerara Electric Company also has control of the electric lighting, and, in fact, all the electric power and plant of the city, which contains about 70,000 people.

TROLLEY DECORATION.—A cheap but effective plan of street decoration, adopted in Cleveland for a "home week" celebration, is to make ornamental pillars of the poles. In Cleveland they are enclosed with wood, fashioned and painted to imitate marble. Wreaths of golden-rod entwine the columns, and a spray of five arc lights surmounts each. The columns are connected with each other and with the adjacent buildings by festoons of bunting and electric lights, the latter encased in Japanese lanterns. A long section of the principal street will thus be decorated, and a striking effect is looked for from an expenditure of only $1,200.

IN A THROAT DARKLY.—The trial of a man accused of having stolen a diamond worth 10,000 rupees from a Calcutta jeweler's shop was recently concluded and the thief was sentenced to two years' imprisonment. A photograph of his throat taken by means of the Röntgen rays showed that the man had adopted the plan common among Indian thieves of first swallowing the jewel and then adroitly guiding it into the sac of the throat, whence he could reproduce it whenever he liked. Yet, in spite of the testimony of the X-rays, all efforts to extract the jewel from his throat failed. This, however, did not interfere with the verdict.

SOFT COAL IN NEW YORK.—The scarcity, or threatened scarcity, of anthracite on account of the coal strike, has led various concerns in New York to use soft coal. The Health Department has been after these for violation of the smoke ordinances, and as a consequence Superintendent W. J. Bonshea, of the Edison Duane Street station, was arrested a few days ago. He gave bail for trial in the Special Sessions. Charles Florence, of the same company's East Twelfth Street station, and Albert King, of the United Electric Light Company, were also arrested on similar charges. Many other arrests have been made.

ELECTRIC TRACTION IN HOLLAND.—The Zuid-Hollandsche Elcktrische Spoorweg Maatschappij is the title of a company formed for the purpose of constructing an electric railway to connect Rotterdam with The Hague and Scheveningen. The authorized capital is 3,000,000 florins of ordinary shares and 4,000,000 florins of obligations, and of the latter 1,000,000 florins in 4½ per cents are now being raised in Amsterdam and Rotterdam. It is estimated that the railway, which is promoted by Dutch and German capitalists, will be completed in 1903, at a cost of 7,800,000 florins, and it is due to this combination that the whole of the plant for the railway and all the electrical machinery have been ordered from Siemens & Halske, of Berlin.

ELECTRIC LIGHT BUREAU OF INFORMATION.—An association has been formed in Kansas City, Mo., for the safeguard of the water, electric light and gas interests in Arkansas, Iowa, Kansas, Missouri, Nebraska and Oklahoma. Its title is the Water and Light Bureau of Information, and the principal office is in Kansas City, Mr. George M. Myers being general manager. The association has a legal department which prepares contracts and franchises for its members, furnishes written opinions on all questions of law, and keeps its members advised of all legislation and decisions affecting water and light companies. The bureau expects to ultimately take in the water and light companies in every State and Territory in the United States.

WIRELESS TELEGRAPHY IN THE NAVY.—A Washington despatch of Oct. 3 reports that negotiations are about to be reopened between the Navy Department and Mr. Marconi for installing the system on board ships of the United States navy. The previous negotiations, it will be remembered, came to an end because the Department regarded the price named by Mr. Marconi for the use of his system as excessive. At that time he wanted $10,000 royalty and $10,000 for each set of instruments installed. Recently the Department has learned that the British Admiralty has secured the use of the Marconi invention at the rate of £200 per each installation, and has placed instruments on board 32 warships. The Navy Department regards that rate as reasonable, and will make overtures to Mr. Marconi in the hope of securing as good terms.

ELECTRICAL GUN.—The London *Times* describes an electrical gun invented by Mr. James Judge, an engineer, of Newcastle-on-Tyne. The gun is a patent centrifugal quick-firing machine gun; it is five feet high and weighs about five hundred pounds. The motive power is electricity, transmitted to a motor attached to the side of the gun. The motor causes a disk to revolve at a very high rate of speed. The bullets, which are introduced into the interior of the disk at the axle, travel along curves in the interior to the circumference and are there impelled through a barrel. It is claimed that this disk will rotate, under the influence of the motor, at the rate of 12,000 revolutions a minute, and will eject shots from the muzzle of the gun with an initial velocity of 2000 feet per second. One of the chief characteristics of the gun is that it will maintain a continuous fire. If necessary, a shot may be discharged at every half revolution, but in practice one shot every fourth revolution will be found sufficient. The bullets are spherical and measure 3-16-inch in diameter.

A LITTLE GIRL'S HOOP.—A special dispatch from Washington of Oct. 4 says: "Part of the Washington street car system was tied up to-day by a little girl's hoop. Late this afternoon she was rolling the hoop along C Street Northeast, when it rolled on the tracks of the electric railroad. Just as a car came along the hoop fell into the slot between the tracks. The hoop got white hot. The car stopped with a jerk, and in a few moments a crowd was gathered around the strange obstruction. No one dared touch it or even approach very near. Before long the cars which came along behind

the first car were halted, and there was a blockade all along the line. All sorts of schemes were tried and all failed. It was half an hour before the employees of the road gave it up and telephoned to the power house to turn off the power, and it was long after that before traffic on the street was in normal condition. The child during the whole disturbance had been crying and lamenting the loss of her hoop." As a result of this incident, the trundling of hoops in Washington has been forbidden by a police ordinance.

POCKET TELEPHONE.—Mr. Evan Shelby, manager of the Lafayette (Ind.) Telephone Company, has invented a pocket telephone for the use of police patrolmen in cities. The plan is to place small boxes on telephone poles in various parts of the city, equip each box with a battery and connect them with the central office. These battery boxes are about three feet high, a foot in width and ten inches deep. In the bottom of the box, which is to be placed at a convenient height on the pole, there is a jack, into which the plug is inserted to make connection with the central office. Every policeman will carry a pocket telephone, which will enable him to hold communication with anybody in the city who has a telephone. The Shelby pocket telephone is small, and can be conveniently carried in the pocket. On one end is a special transmitter and on the other is the receiver. It is so made that when the receiver is properly placed to the ear, the transmitter is directly in front of the mouth. The receiver and transmitter may be folded together when not in use, and can be adjusted to fit the head. The connection with the central is automatic, and the patrolman may call any number he wants.

LIGHTNING RODS FOR ST. PAUL'S.—A total rearrangement of the system of lightning conductors on St. Paul's Cathedral, London, is now virtually completed. Mr. Killingworth Hedges, M.I.E.E., the electrician under whose superintendence the work has been carried out, says that the old idea that the erection of a lightning rod on the highest point of a structure protected an area all around it is quite illusory. The safeguarded area was supposed to be the space within a circle whose radius was equal to the height of the lightning rod. This theory, we understand, is now discredited, and the cathedral has been protected by a system of conductors, perpendicular and horizontal, comprising over a mile of cables, on which at various prominent points are placed about fifty "aigrettes"—groups of solid copper spikes radiating upward, and effectually connected at the base with the cables. The old system of joint making by "junction pieces," or splicing and soldering, has also been abandoned, it having been found that if surfaces were merely screwed together they were apt to oxidize and set up resistance, and if they were soldered the soldering sooner or later would be very likely to become loosened and detached by the natural expansion and contraction of the metals. A new method of running to ground has also been adopted. The usual plan is to connect the conductors with plates of copper embedded deep down in the moist earth, and these plates, to be effective, must be of considerable size. It is often difficult to get them down low enough. At St. Paul's Cathedral they have made earth connections by means of iron pipes perforated at the bottom and driven into the ground by special tackle, thus affording a passage down which the conductor is passed to the necessary depth, and by means of which, if necessary, the earth below may be watered.

LETTERS TO THE EDITORS.

Tractive Electromagnets.

To the Editors of Electrical World and Engineer:

SIRS:—My criticism of Prof. W. E. Goldsborough's article on "The Design of Tractive Electromagnets" was written with the intention only of correcting manifest errors, and not to provoke controversy, which could prove of no benefit to the readers of this journal.

However, after having seen my plain demonstration of the inaccuracy of his conclusions—a demonstration based on fundamental laws and worked out by simplest mathematics—Prof. Goldsborough hastens to the rescue of such as might unwittingly be led astray by my "erroneous criticism."

Inasmuch as neither fundamental laws nor plain mathematics will alter themselves, whatever the occasion, there can be no controversy, and I leave to the readers who are interested in, and understand, this subject, to judge of the relative accuracy of the two communications.

LAMAR LYNDON.

Baltimore, Md.

Theories of Gravitation.

To the Editors of Electrical World and Engineer:

Sirs:—From your extremely interesting editorial in your issue of Sept. 29 I judge that I have not sufficiently emphasized the fact that my theory of gravitation rests upon a firm experimental foundation, more complete than is usually the case with new theories. I should not have made my assertion so emphatically definite as I have done had I not ascertained by experimental evidence that there was no risk of it proving incorrect.

I will briefly point out the chief experiments upon which this theory rests.

1. Quincke's experimental determination of the fact that dielectrics do alter their volumes under electric stress.

2. My own discovery that all simple dielectrics expand under electric stress, while compound or ionized dielectrics contract.

3. Kerr's experimental discovery that the velocity of light changed in passing through a dielectric under electric stress, the amount of such change being proportional to the square of the electric intensity.

4. My discoveries, A that this change is an acceleration in the case of simple dielectrics, and a retardation in the case of mixed or ionized dielectrics. B, that this change varies inversely as the volume elasticity.

5. The experiments on the aberration of light and other optical phenomena which show that the effect of matter on the velocity of light is an additive one to that of the ether. Also the other phenomena mentioned in my paper on the nature of electricity.

I have shown that where electric and magnetic forces are concerned we have pairs of phenomena, one set due to matter and the other to ether. I have also shown that Kerr's effect must be due to a change in density, otherwise the effect would vary as the first and not as the second power of the electric intensity.

We thus have a perfectly sufficient amount of experimental evidence to show that there is a change of density in the material dielectric. And from the theorem mentioned above, which has been corroborated in a number of cases by me both for magnetic and electric phenomena, and which is absolutely necessitated by optical phenomena, we must have a corresponding change in the density of the ether itself.

I have also ascertained that the amount of this change in density is sufficient to account for the gravitation connected with the corpuscle.

Such a change in density had previously been shown by Newton to give a gravitational effect.

On considering these facts it will be seen, I believe, that this is not merely an hypothesis which "until experimental proof is forthcoming can only be a guess," but is a fully developed theory founded on a solid experimental basis.

I may add that I have recently calculated the velocity of the compressional gravitational wave, by considering the amount of gravitational energy of the corpuscle, in connection with the known amount of electrostatic stress around it. From this I have derived the value of the compressional modulus of the ether, and taking this in connection with the value of the ether density which I have previously given elsewhere, have determined the velocity of the wave. I have made arrangements to investigate Kerr's phenomenon more exactly than in my previous work, and from it I hope to obtain corroborative evidence of my determination of the value of the density of the ether.

At first sight it may be difficult to see why there should be any expansion or contraction due to the electrostatic field, since the longitudinal tension is accompanied by an equal lateral pressure, as Maxwell has shown. It becomes plain, however, how this can happen if we consider the case of india rubber. I have shown (*Science*, July 2, 1892, and March 3, 1893; also Molecular Physics, Franklin Institute, September, 1896), that this material is made up of two substances, "like a skein of silk embedded in jelly," and that this explains its heating on stretching, contracting when heated and stretched, and the peculiar shape of its elastic curve. Now suppose that in such a substance a longitudinal tension is put on the silk-skein stuff, together with an accompanying lateral pressure of the same amount, it is easy to see that there will be a resultant increasing density.

Now I have previously pointed out (in my *Physical Review* paper for January, 1900, p. 5), that the form of the relation between magnetizing force and magnetization shows that the elastic properties of

the ether resemble those of rubber. This is also confirmed by the high value of the velocity of the compressional wave in ether, i. e., the velocity of gravitational propagation, compared with the velocity of light. And this rubbery nature is just what we would get from a vortex ether.

In his book on matter and ether, Larmor has pointed out some difficulties which are met with in assuming the electrons to be vortex singularities. But I think these can all be got over by assuming that there is only one vortex, knotted up into inextricable confusion, and that consequently the circulation is the same everywhere. If this hypothesis were correct, the severance of this vortex, which might perhaps be called the umbilical cord of the universe, at any point, would involve the disappearance of all matter.

The evidence in favor of my theory may be summarized as follows:

First, the fact, demonstrated and demonstrable by experiment, that there is a change in density in a dielectric under the influence of electric stress, proportional to the square of the electric intensity.

Second, the fact, absolutely necessitated by the existence of a number of other physical phenomena, that there is a similar change of density in the ether.

Third, the fact that such a change of density is, without possibility of contradiction, as was shown by Newton, capable of giving rise to a force acting in the same way as gravity does.

Fourth, the fact that the calculated change of density on this theory agrees approximately with that necessary to give the amount of gravitational force which we know the corpuscle has connected with it.

Fifth, the fact that this theory alone gives definite reason for the constant ratio between mass and gravity.

It is difficult to see how evidence more definite in character could possibly be adduced, and any further experiments can only be considered as multiplying evidence. This theory of gravitation is the first and only one with a definite experimental basis.

REGINALD A. FESSENDEN.

ROCK POINT, CHARLES CO., MD.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Temporarily Conducted by E. F. ROEBER, Ph. D.

DYNAMOS. MOTORS AND TRANSFORMERS.

Starting Induction Motors.—DERI.—An illustrated description of induction motors designed by him, with a special device for starting. Groups of windings of the armature are connected with resistances, that are always connected with the armature, but are supplied with current only at starting, which is accomplished by using a different number of poles at starting and later at running. The principle of the arrangement may be seen from the adjoining figures. Figs. 1 and 2 represent exactly the same winding, and the starting resistances

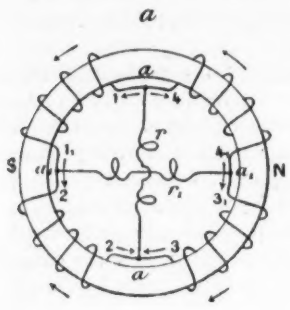


FIG. 1.—TWO POLES.

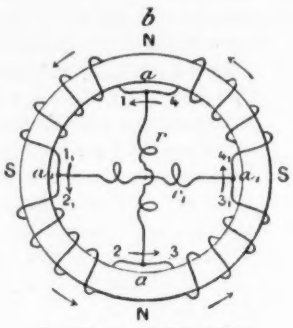


FIG. 2.—FOUR POLES.

r and r_1 are connected to the winding in exactly the same way in both cases; the winding and the connections of the auxiliary resistances r and r_1 are so arranged that with two poles, as in Fig. 1, the

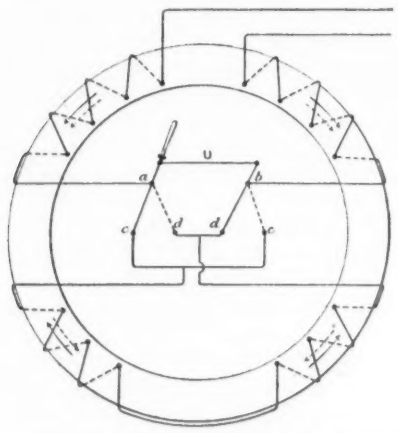


FIG. 3.—SWITCH FOR VARYING THE NUMBER OF POLES.

sum of all e. m. f.'s in the winding is zero, while in Fig. 2, with four poles, all e. m. f.'s are in series. In the latter case, therefore, no current flows through the starting resistances, while in the first case current is supplied to them, as seen in the figures. Hence, when the motor is started with two poles, the starting resistances are supplied with current; when the motor has run up to full speed, it is changed over to four poles, so that no current is flowing any more through the starting resistances. How this change of the number of poles is done can be seen from Fig. 3. The position of the switch marked with straight lines gives four poles; the position marked with dotted lines gives two poles; the rod U is of a non-insulating material. A motor based upon these principles was exhibited in the Austrian part of the Paris Exposition.—*L'Ind. Elec.*, Aug. 10.

REFERENCES.

Transformers.—WIRT.—A paper read before the Pacific Coast Elec. Transmission Ass'n on "The latest development in transformer design and operation." He dealt with the insulation between the primary and secondary coils; he urged that heating tests should be made with the resistance method, as thermometers give generally the temperatures of the coils too low, especially in the shell type of transformer; he finally called attention to the importance of transformers with a small core loss. The discussion which followed is also reproduced.—*Jour. of Elec.*, Aug.

Induction Motor Diagrams.—EMDE.—An illustrated communication referring to the paper of Ossanna (Digest, Sept. 15), who bases his three-phase motor diagram upon a diagram for the general transformer, introduced by Behrend. The writer shows that this diagram of Behrend is not in full agreement with an analogous diagram of Heyland. He explains why he thinks that there is a mistake in Behrend's theory.—*Elek. Zeit.*, Sept. 13.

Rotary Converters versus Rectifiers.—JANET.—This paper, in full, read before the Internat. Elec. Congress, and abstracted in the ELEC. WORLD AND ENG., Sept. 22, p. 449.—*L'Eclairage Elec.*, Aug. 25.

Polyphase Motors.—GILES.—The conclusion of his long mathematical article on the calculation of polyphase motors (Digest, July 7). In this part he gives a numerical example to show the practical application of his formulas.—*L'Elcairage Elec.*, Aug. 25.

Starting Three-Phase Induction Motors.—An anonymous communication, criticising some formulas in Guillaume's article, noticed in the Digest Sept. 1.—*L'Ind. Elec.*, Aug. 25.

Testing.—HERTNER.—An illustrated article describing methods of dynamo and motor testing.—*The Eng.*, Oct. 1.

LIGHTS AND LIGHTING.

Alternating Enclosed Arc Lamps.—HILLMAN.—A long, illustrated paper, read before the Pacific Coast Elec. Transmission Ass'n on "Arc lighting in power transmission service." He first deals with the use of the alternating enclosed arc lamps for interior lighting and discusses the weak points which these lamps have had in the past, and the remedies which have been successfully applied. He urges power transmission companies to push this lamp for interior lighting; wherever competition from Welsbach's is keen, the advantages of the 4-ampere alternating lamp should be considered; it should be furnished in the single-globe type; at a rate of 10 cents per kilowatt-hour, the 4-ampere lamp can be operated two hours per day for one

month, and the bill will be $1.50. He then discusses street lighting by alternating enclosed arcs, and makes some remarks on constant current transformers. He gives an estimate of the cost of the constant current series alternating system for street lighting, with constant current transformers, compared with a plant where direct current open arcs are being operated from arc machines driven by an alternating current motor; he assumes a plant operating 550 lamps, and finds that with the alternating enclosed arc lamps a saving of $2.28 per lamp per year is obtained, due to the increased efficiency of the system, the cost of the kilowatt-hour being assumed as ½ cent; there is also an annual saving in the maintenance of $9.74 per lamp, of which he gives an itemized statement in proof; therefore there is a total saving of $12 per lamp per year, or a total annual saving of $6,600 for the 550-lamp outfit; the investment necessary for changing over from the direct current open arcs to the alternating current enclosed arcs will be paid for in about 18 to 24 months. He speaks about the care for the inner globe and on the improvement in the character of the light produced, especially the elimination of shadows; he further speaks in favor of the low energy lamp. In the long discussion which followed, and which is reprinted in full, Cory remarked that the power factor of an alternating current lamp is such that it must be met in the regulation; the power factor is not unity, but between 0.8 and 0.85.—*Jour of Elec.*, Aug.

Behavior of Incandescent Lamps During Thunderstorms.—Two communications, by Langden and Blackmore, on effects of lightning flashes upon installations of incandescent lamps. Blackmore has noticed in the Transvaal the peculiar phenomenon observed in Calcutta and described in the Digest Sept. 22. He, however, does not accept the explanation based upon the coherer theory, but thinks that "the pulsating which the lights were subjected to was due to the effect of mutual induction between the lightning flash and the overhead conductor, which takes the form of a very high potential oscillatory current, which disappears entirely with the lightning flash." He gives also an account of other observations made in electric installations in the Transvaal during lightning storms.—Lond. *Elec.*, Sept. 21.

HARDEN.—A communication referring to observations made during lightning storms in an electric light installation. He concludes from them that the lightning flash is an oscillatory discharge of a very high frequency.—*Elek. Zeit.*, Sept. 20.

REFERENCES.

Luminous Efficiency of Incandescent Lamps with Carbon Filaments.—WEISSMANN.—His paper, in full, read before the Internat. Elec. Congress and abstracted in the ELEC. WORLD AND ENG., Sept 15, p. 356.—*L'Eclairage Elec.*, Sept. 1.

Progress in Electric Lamps.—BLONDEL.—His paper in full, read before the Internat. Elec. Congress and abstracted in the ELEC. WORLD AND ENG., Sept. 15, p. 410.—*L'Eclairage Elec.*, Sept. 1; a translation in abstract in *West. Elec.*, Sept. 29.

Electric Gas Lighting Device.—An illustrated translation of the French article noticed in the Digest Aug. 25.—*Sc. Amer. Sup.*, Sept. 29.

POWER.

Electric Brakes for Alternating Currents—FISCHER-HINNEN.—An illustrated article in which he shows how to calculate electric brakes for cranes, the electric current being used simply for releasing the brake, which is entirely mechanical in all other regards. The consumption of watts is very small, and the dimensions must be so calculated that the volt amperes are a minimum. He describes a device for releasing the brake, used on three-phase cranes of Krizik; it has the advantages that it can easily be predetermined and that it gives a nearly constant tractive force over a long way. The apparatus consists in its essential parts of a stationary field of the type of induction motors and an armature which can revolve by 90 degs., the armature being in series with the field. He develops the formulas for single phase, two-phase and three-phase currents and gives numerical examples.—*Elek. Zeit.*, Sept. 13.

Electric Power.—ADAMS.—An article on "The transition to electric power." He refers to the concentration of industrial concerns in the neighborhood of large water powers and to the use of electric power, which makes the total water power available for power purposes. The delivery of all water power electrically makes the compact and economical arrangement of all hydraulic works and apparatus easy, however widely the users of the energy may be scattered. This expansion of service affects the number and the character of power users, and offers advantages especially to manufacturers of small and medium capacity.—*Cassier's Mag.*, Oct.

REFERENCES.

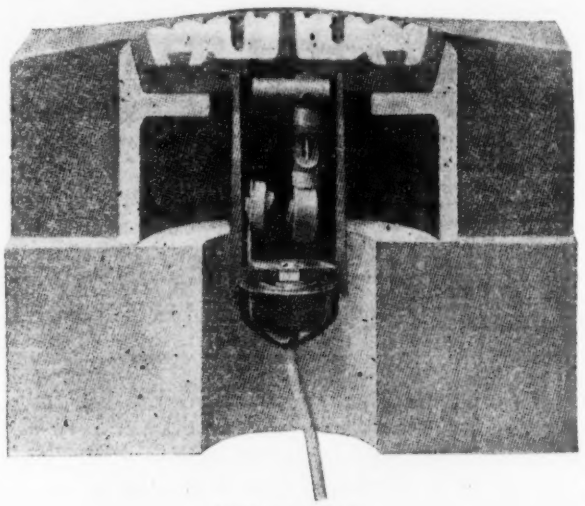
Gearing for Electric Motors.—GIBBINGS.—A well-illustrated article, in which, after some general remarks on the application of electric motors to driving machinery, he gives several examples of some modern forms of gearing. He discusses the following four cases: Short drives, variable speed gear, definite reductions with a wide difference in speed, definite reductions in which the speed ratio does not exceed 10:1.—*Cassier's Mag.*, Oct.

Great Britain.—BOOTH.—An article on "Electric power distribution in Great Britain," referring to recent power schemes and the great difficulties arising from the obstinacy of some municipalities. "No matter from what direction the question of municipal trading is looked at, very serious difficulties present themselves, nor has the management of undertakings that are essentially the duty of the municipality ever been marked by such ability as to warrant their interference in so national and vital a question as the distribution of power."—*Eng. Mag.*, Oct. The same number contains a long abstract of an article of Prof. Ayrton on the Brit. power bills, from *Nature.*

Transmission System Regulation.—An editorial on transmission in long distance lines, with special reference to the papers of Perrine and Cory, abstracted in the Digest Aug. 25.—*Jour. of Elec.*, Aug.

TRACTION.

Dolter Surface Contact System.—REYVAL.—An illustrated description of the Dolter surface contact system, which is operated on an experimental line in Paris. The contact blocks, placed in the midst between the two rails, are on a level with the rod and are firmly fixed by means of cross-beams connected with the rails. The construction of the contact block may be seen from the adjoining figure. At the



CONTACT BLOCK.

top there are two half disk pieces of steel embedded in ambroine; on the right-hand piece is pivoted a horizontal iron rod, to which is firmly connected at the right end a vertical tube of ambroine which bears at its lower end a contact disk of carbon; this carbon disk and the upper horizontal iron rod are connected together by a fuse wire of aluminum in the interior of the ambroine tube. The upper horizontal iron tube is connected by two flexible wires with the two halves of the contact block. When the upper horizontal iron rod is magnetically attracted upward, the firmly connected iron rod and ambroine tube swing together around the pivots and the carbon disk at the lower end of the ambroine tube is pressed against the other carbon disk at the left hand, which is fixed on a spring and is in connection with the supply feeder, as shown in the illustration. In this way the contact block is connected with the supply feeder. Below the tram car there are two shoes, or skates, consisting of two iron rods, which form the pole pieces of a big electromagnet, one skate being the north pole, the other skate the south pole. One end of the exciting coils of the electromagnet is connected with one skate, the other end with the controller of the car. The coils of the electromagnet are thus excited by the current which drives the motors of the car; in the moment of starting, and in such cases when by chance the connection should be broken, the exciting current for the electromagnets is furnished by a small storage battery in shunt with the

exciting coils. The skates have a length of 21 ft., so that they span the distance between two adjoining contact blocks. There is also a special device to prevent any danger in case a contact block remains alive after the skates have passed it; this is accomplished by a "safety sliding contact" at the end of the car, for connecting the contact block, over which the skates have passed, with the rails through a resistance of 2 ohms; if this contact block is dead, no effect is produced; if it is still alive, the aluminum wire in the ambroine tube, mentioned above, is fused, and the contact block is disconnected from the supply feeder.—*L'Eclairage Elec.*, Aug. 11; *L'Ind. Elec.*, Aug. 10; *L'Elec.*, Aug. 25.

Electrolysis of Underground Metal Structures by Tramway Return Currents.—A reprint of the paper of Maury, abstracted in the Digest Aug. 4, with some editorial notes on it. "We do not admire Mr. Maury's proposed solution of the difficulty. Having carefully examined on the spot 'the double trolley system, overhead, as in Cincinnati,' we relegated it to the limbo of curious failures. Better far than this ærial nightmare to provide the ordinary trolley with an underground insulated return connected permanently to a series of surface contact-studs on the track. We do not think this has ever been tried. The principal drawback to the surface-stud systems in their entirety is the complicated mechanism necessary for rendering the studs alive only when a car is over them. The difficulty vanishes when all the studs are on the return conductor and are never at more than, say, 7 volts above earth potential. This would be but little more costly than the ordinary trolley system, especially when it is remembered that much paraphernalia in the shape of rail bonding, negative boosters, etc., would be rendered unnecessary. Moreover, it is a modification that any trolley traction company or authority, with proclivities in underground corrosion, can be made to adopt at any time without involving serious change in the electrical system of working."—Lond. *Elec.*, Sept. 21.

REFERENCES.

Electric Traction.—Postel-Vinay.—A paper, read before the Internat. Elec. Congress, on the different devices which have been proposed and used for conveying the electric current to the tram cars. He gives a long historical résumé of the evolution of the trolley system and gives also some notes on conduit and surface contact systems.—*L'Eclairage Elec.*, Aug. 25.

Trolley-Fed Automobiles.—Aldridge.—An illustrated Brit. Ass'n paper on "the automobile for electric street traction." He dealt mainly with the type of the trolley-fed automobile, an illustrated description of which was given in the Elec. World and Eng. Mar. 10, p. 358. The discussion which followed is also abstracted.—Lond. *Elec. Rev.*, Sept. 21.

Electrical Canal Traction in Belgium.—Desombre.—A very long and fully illustrated article on three-phase traction on the canal between Brussels and Charleroi, noticed in the Digest Aug. 11.—*L'Eclairage Elec.*, Aug. 4.

New York.—Rogers.—His presidential address to the N. Y. State St. R'y Ass'n on "Street railway affairs in the State of New York," noticed in the Elec. World and Eng. Sept. 29, p. 488.—*West. Elec.*, Sept. 29.

Paris.—An article on the electric installation of the extensions of the Orleans Railway into the centre of Paris.—*L'Ind. Elec.*, Aug. 10.

Installations. Systems and Appliances.

Switches.—Passavant.—A brief article explaining that the rules of the Union of German Elec. Eng. require that the switches for disconnecting any kind of electrical apparatus from the supply circuit must be arranged in such a way that no part of the apparatus behind the switch is at a potential different from earth, and that therefore in a two-wire system both poles must be disconnected, in a three-phase system all three phases of the apparatus; this is required especially for starting resistances of three-phase motors, etc. —*Elek. Zeit.*, Sept. 13.

REFERENCES.

Use of Condensers in Practical Work.—Boucherot.—His paper in full, read before the Internat. Elec. Congress and abstracted in the Elec. World and Eng. Sept. 22, p. 450.—*L'Eclairage Elec.*, Aug. 25.

Method of Charging.—De Fodor.—His paper, read before the Internat. Elec. Congress in Paris, on "A proposed method of charging for electric current," abstracted in the Elec. World and Eng. Sept. 15, p. 412.—*West. Elec.*, Sept. 29.

Electricity in Agriculture.—Renaud.—An illustrated abstract of the French article, noticed in the Digest June 2, 16.—*West. Elec.*, Sept. 29.

Switch Gears.—Warrilow.—A continuation of his illustrated serial on the evolution of switch gears for high pressure alternating current. This part deals with Ferranti switch gears.—Lond. *Elec. Eng.*, Sept. 21.

Lightning Arresters.—Illustrated communications, discussing the best and most useful forms of earth plates used for lightning arresters.—Lond. *Elec. Eng.*, Sept. 21.

Barnsley.—A very long illustrated description of the electric plant of Barnsley. The three-wire direct current system is used. The total capacity of the machines is 375 kilowatts. There is also a battery of 260 cells with a capacity of 500 ampere-hours at 100 ampere discharge. —Lond. *Elec. Eng.*, Sept. 21.

Glasgow.—A continuation of the illustrated description of the new electrical plant of Glasgow (Digest, Oct. 6.). The machinery at present working consists of seven direct coupled sets, with a combined output of 6000 horse-power; there is also a storage battery of 335 Tudor cells, arranged in two sets on the 500-volt three-wire system, the capacity being 1100 ampere-hours at a discharge of 150 amperes.—Lond. *Elec.*, Sept. 21; other illustrated descriptions begin in Lond. *Elec. Rev.* and *Elec. Eng.*, Sept. 21; a more condensed illustrated description in *Lightning*, Sept. 20.

Wires, Wiring and Conduits.

Heating of Electric Cables.—Herzog and Feldmann.—A long article, giving an account of a series of experiments regarding the heating of cables in air and in earth, and developing also a theory. They reach the following conclusions: It is desirable that manufacturers of cables give the dimensions and the physical constants of the cables; under consideration of the placing of the cables, the curves showing the heating and cooling can be found approximately. The limits of the temperature which may be allowed are found by the following considerations: The heating must not hurt the insulating mass; the limit of temperature in this regard is given by the manufacturer and is generally much higher than a temperature which occurs in practice; the rise of temperature must not diminish the insulation resistances too much; there is, in fact, a great decrease of the insulation resistance; for instance, for impregnated jute the insulation resistance at 0 deg. is three times greater, and at 30 degs. 83 times smaller than at 15 degs. They have found in practice that in high tension cables, although the insulating resistance of the heated cables becomes smaller, yet the insulating mass becomes viscous, and pores which may be in the mass are closed, so that the danger of a breakdown is more diminished than increased; in a special case they have supplied a concentric cable of 2 mm^2 x mm^2 cross-section with 10 amperes per mm^2, and have operated it for several months for some hours daily at 3000 volts alternating current without any breakdown or damage. The desire to save by choosing a small cross-section should not be exaggerated. The specification, much in use, requiring a guaranty for 2 amperes per mm^2 is insignificant and not justified, as it is not in accordance with the real facts. For voltages of 10,000 or more, and for high frequencies, the dielectric hysteresis and the hysteresis and eddy current loss in lead and iron mantles must be considered. If the cables are placed in running water or in air in motion, the conditions for cooling are more favorable than if placed in earth or in air not in motion.—*Elek. Zeit*, Sept. 20.

REFERENCES.

Cable Insulation.—Wright.—An article on "The ethics of insulating materials." He describes the single steps in manufacturing rubber insulated cables and gives some notes on insulation with guttapercha; bitite, which is used in the Callender cables, and consists essentially of purified, vulcanized bitumen; fibre, and paper. "What is urgently required is a substance which, while possessing the durability, elasticity and imperviousness of rubber, shall be cheap and yield good results electrically; *i. e.*, it must possess a low specific inductive capacity and a high specific resistance under all ordinary conditions, and, above all, be capable of easy application to the wire or cable which it is intended to insulate. Such a substance is not at present on the market."—Lond. *Elec. Rev.*, Sept. 21.

Electric Supply Mains.—A reprint of the model form of the general terms and conditions in contracts for electric cables and mains, issued by the Brit. Cablemakers' Ass'n, with a table giving the standard sizes of conductors for electric supply mains, to become operative in Oct., 1900.—Lond. *Elec.*, Sept. 14; *Elec. Eng.*, Sept. 21; some critical notes on this subject in Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Sept. 21.

Cables.—Maver.—A well illustrated article on the manufacturing process of electric cables for high tension service, with some remarks on the methods of testing them.—*Cassier's Mag.*, Oct.

Electro-Physics and Magnetism.

Analysis of Alternating Current Waves.—Des Coudres.—An illustrated article describing a "direct method" for determining the upper harmonics of an alternating current. The method is called "direct" as it is not necessary first to determine the wave form of the alternating current. The principle of the method is based upon the following observation: If the movable coil of a torsion electrodynamometer is supplied with a sine current and the fixed coil with another sine current of different frequency, there is no deflection of the pointer of the instrument as long as the two frequencies vary greatly; when the frequency of the one current is brought nearer to that of the other current, the pointer begins to oscillate; only when the two frequencies are exactly equal is there a distinct deflection of the pointer. When, then, two readings are taken for two phases in the current in the movable coil, differing by 90 degs., then the amplitude and phase of the current in the fixed coil can be determined if the amplitude and phase of the current in the movable coil are known. This determination of the amplitude and phase of the sine curve of the special frequency in this fixed coil is entirely independent of the presence of other sine curves of other frequencies in the fixed coil. His method is, therefore, as follows: The alternating current which is to be analyzed and has a frequency n, is supplied to the fixed coil of the dynamometer. The wave form of this current can be written as a sum of pure sine waves of the frequencies n, $2n$, $3n$, etc., as is well known from Fourier's theorem. If, now, for instance, the harmonics with the frequency $3n$ is to be determined, the flexible coil is supplied with a current of a pure sine wave of the frequency $3n$ and of known amplitude and known phase, and a reading is taken, then the phase of the latter current is changed by 90 degs., all other things remaining as before, and another reading is taken. From these two readings the third harmonic of the alternating current supplied to the fixed coil can then be found, as shown above. He describes experiments to prove that his method is practical and has certain advantages over other methods.—*Elek. Zeit.*, Sept. 6, 13.

Coherer Theory and Practice.—Bose.—A communication referring to his researches on the coherer or "molecular receiver," as he calls it (Digest, March 24, Oct. 6.). He draws attention to the reversal effect produced by electric radiation when the intensity falls below the critical value. If the receiver consists of a mass of metallic particles, it follows that the outside particles will exhibit the normal, say the positive, effect; as the radiation gets absorbed in passing inward, a reversed or negative effect may take place in the particles in the interior, so that the resultant effect will be a differential one. From these theoretical considerations he draws the following conclusion for wireless telegraphy practice; as in this case the intensity of traction is very feeble and near the critical value, it follows that Lodge's method of single contact should be a more sensitive arrangement than the method of contacts in multiple.—Lond. *Elec.*, Sept. 21.

Mechanical Action of Cathode Rays.—Starke.—An account of preliminary experiments made to determine the force exerted by cathode rays upon light, movable bodies. He used a cathode with a number of plates resembling a propeller; the cathode was kept fixed, and the cathode rays impinged at an angle of 45 degs. upon a thin plate of aluminum suspended above the cathode by means of a thin platinum wire. The results were nearly all negative.—*Ann. der Physik.*, No. 9; abstracted in Lond. *Elec.*, Sept. 21.

Conductivity of Pressed Powders.—Streintz.—An account of experiments in which he put fine powders of platinum black, graphite and lamp black under pressure into a hole bored in a block of ebonite and determined their resistance by electrodes inserted in the block. Lamp black showed a negative temperature coefficient of 1 per cent for 1 deg. C.—*Ann. der Physik*, No. 9; abstracted in Lond. *Elec.*, Sept. 21.

Atmospheric Electricity.—McAdie.—A brief illustrated paper read before the Pac. Coast Elec. Trans. Ass'n, in which he urged that measurements of the energy of the average flash of lightning should be made. He also gives an account of a set of experiments made in Washington, where the difference of potential between the ground and currents in air at different elevations were measured. At the top of the Washington Monument, during severe thunderstorms, variations in the potential exceeding 7000 volts were obtained.—*Jour. of Elec.*, Aug.

Magnetization of Electrolytic Iron.—Maurain.—An account of experiments in which he investigated the magnetic properties of electrolytic iron in the act of deposition, and deposited iron under the influence of magnetic fields of various intensities. The coercive force and residual magnetism of such deposits are high. There is practically no loss of magnetization after the removal of the field; it even resists an opposite field, when the latter is not too strong, but when the opposite field attains a certain strength the collapse of the magnetization is sudden and complete. Nickel, similarly deposited, though showing the same remanent magnetism, exhibits a gradual diminution of magnetism with an increasing demagnetizing force.—*Comptes Rendus*, Aug. 13; abstracted in Lond. *Elec.*, Sept. 21.

REFERENCES.

Dielectric Strength.—Bouty.—An account of an experimental investigation, the measurements being made between two plane and parallel electrodes. Apart from the lowest pressures, the dielectric strength varies with a pressure in a linear manner.—*Comptes Rendus*, Aug. 20, 27; abstracted in Lond. *Elec.*, Sept. 21.

Propagation of Electric Waves Along Parallel Wires.—Morton.—A very brief abstract of a Brit. Ass'n paper, in which he gives a contribution to the theory of the propagation of electric waves and corrects an error in previous researches of Thomson, Somerfeld and Mie.—Lond. *Elec.*, Sept. 21.

Electrons.—An editorial on the theory of electrons, with special reference to a discussion on this subject held at the recent meeting of the Brit. Ass'n.—Lond *Elec.*, Sept. 21.

Electromagnetic Mechanisms.—S. P. Thompson.—His paper, read before the Internat. Elec. Congress and abstracted in the Elec. World and Eng. Sept. 15, p. 411.—*L'Eclairage Elec.*, Aug. 25.

Electromagnets.—Edelmann.—An illustrated description of different forms of electromagnets for experimental purposes.—*Elek. Zeit.*, Sept. 20.

Electro-Chemistry and Batteries.

Change of E. M. F. During Chemical Reactions.—Zenghelis.—An abstract of a paper read before the Internat. Congress for Applied Chemistry. He starts from Nernst's formula for the e. m. f. between a metallic electrode and a solution of a salt of the same metal. This e. m. f. depends upon the osmotic pressure, which is proportional to the concentration of the ions of the metal. Hence, if all other quantities remain constant, a variation of the concentration can be found from the variation of the e. m. f. He applies this principle for several experimental purposes, for instance for the determination of the quantity of salt or metal, contained in a solution.—*L'Eclairage Elec.*, Aug. 11.

REFERENCES.

Electrochemistry.—Minet.—An abstract of a paper, read before the Internat. Congress of Applied Chemistry and giving a summary of the development of electrochemistry and the present conditions of the electrochemical industries.—*L'Eclairage Elec.*, Aug. 4.

Chemical Industries.—Berthelot.—An abstract of a paper, read before the Internat. Congress for Applied Chemistry, on the evolution of the methods in the chemical industries, especially on electrical methods in chemical processes.—*L'Ind. Elec.*, Aug. 10.

Organic Chemistry.—Marie.—An abstract of a paper read before the Internat. Congress for Applied Chemistry, on the application of electrical methods for the preparation of organic compounds.—*L'Eclairage Elec.*, Aug. 18.

Analytical Chemistry.—Dupont.—An abstract of a paper read befor the Internat. Congress for Applied Chemistry, on new applications of electrolysis in analytical chemistry. He deals with methods for the preparation and extraction of different kinds of sugar and with the estimation of potash and soda in beet juice.—*L'Eclairage Elec.*, Aug. 11.

Electrolytic Analysis.—Abstracts of two papers read before the Internat. Congress for Applied Chemistry; one by Hollard, on the principles of electrolytic analysis; the other by Marie, on the electrolytic estimation of lead.—*L'Eclairage Elec.*, Aug. 11.

Electrolysis.—Brochet.—An abstract of a paper read before the Internat. Congress for Applied. Chemistry; one by Holland, on the count of an experimental investigation of the electrolysis of concentrated solutions of hypochlorites.—*L'Eclairage Elec.*, Aug. 11.

Calcium Carbide.—Abstracts of several papers read before the Internat. Congress of Applied Chemistry: Gin, on the calcium carbide industry in Austria; Mathews, on that industry in the United States and Canada; Rossel, on that industry in Switzerland.—*L'Eclairage Elec.*, Aug. 4; an abstract of a paper of Gin on the action of calcium carbide upon some organic substances; also abstracts of

papers by Hubon, Sabatier and Senderens on acetylene in *L'Eclairage Elec.*, Aug. 11.

Units, Measurements and Instruments.

Weston Cell.—Cohen.—An account of an investigation in which he has found an important flaw in the perfection of the cadmium cell as a standard of e. m. f. Not only can cadmium sulphate in the form used exist in two modifications below 15 degs., but the cadmium amalgam itself is unstable and can exist in two modifications below 23 degs.; the amalgam contains 14.3 per cent of cadmium; at 0 deg. a potential difference of 5 millivolts exists between the two modifications of the amalgam, and this difference is large enough to destroy the suitability of the cell as a standard. The fault is found both in the cells of the German Reichsanstalt and of the European Weston Elec. Inst. Co. The passage from one modification to the other is apparently quite spontaneous. Above 23 degs. there is no danger, but then a constant temperature cannot be insured without the use of a thermostat, and the supposed advantages of the Weston cell, derived from its low temperature coefficient, are thus rendered illusory. —*Proc. Akad. Amsterdam*, Aug. 28; abstracted in Lond. *Elec.*, Sept. 21.

Measuring Magnetic Flux.—Cotton.—A long, illustrated description of a device for measuring the intensity of a magnetic field; it is adapted especially for measuring the field in the air-gap of an electromagnet in the laboratory; also for studying quickly a non-uniform field. The device is a balance with two equal arms; the end of one arm bears adjustable weights to hold the scales in balance. The end of the other arm bears a coil of peculiar shape; it has four sides, two long and bent, and two short and straight; the two long sides are arcs of two concentric circles around the balance-pivot; the two short sides are parts of radii, hence perpendicular to the two long bent sides. The axle around which the balance swings is horizontal, the plane of the coil vertical. The lower short side of the coil is placed into the magnetic field to be measured so that the lines of magnetic induction are perpendicular to the plane of the coil, and it is supposed that the magnetic field at the place of the upper short side is zero. Then the total action of the field upon the whole coil is simply the action upon the lower short side. The magnetic field at that point can therefore be measured by the weight which is required to hold the scales in balance.—*L'Eclairage Elec.*, Aug. 18.

Measuring High Resistances.—Rood.—The first part of a paper, in which he describes a new method for measuring high resistances like 15,000 or 20,000 megohms. In this method the electricity is allowed to slowly accumulate until it reaches a certain potential; the plan is based on the fact that when the resistance is very great the electricity may require ten minutes, or even an hour, before raising the potential of the electrometer to the required degree. He compares the electricity with a thick, pitchy fluid, moving slowly in a long, open tank; if the tank is quite narrow, offering thus great resistance to the passage of the pitchy fluid, then at the end where the fluid is introduced the height or potential will equal that of the supplying source, but as the distance from this end increases, the potential falls and finally becomes zero; this is analogous to the surface conduction of electricity by black sealing wax, jade and gutta-percha. If two tanks of the same length and cross section deliver equal amounts of the pitchy fluid in equal times, their conducting powers are set as equal, and in general the amount delivered per minute by tanks differing from each other is a measure of their relative conducting powers. His apparatus is a modification of a single-leaf electroscope, the whole arrangement amounting "to a kind of unit jar which discharges itself when charged to a certain potential." He describes a series of preliminary experiments with different materials.—*Am. Jour. of Sc.*, Oct.

Protection of Magnetic Observatories.—Moureaux.—A paper on the disturbances produced on the needles of the Parc Saint Maur magnetic observatory by the new electric tramway between Vincennes and Nogent-sur-Marne, which passes at a distance of 3000 yards from the observatory. The disturbances are symmetrical to the natural curve and are of a much greater frequency than the natural fluctuations of the earth's magnetism. They can, therefore, be made practically negligible by using needles of square or rectangular section, strongly magnetized, by increasing the moment of inertia of the swinging system by means of a piece of copper and by damping with copper disks. He has done this with a declinometer and a bifilar magnetometer.—*Comptes Rendus*, July 30; abstracted in Lond. *Elec.*, Sept. 21.

References.

Units of Electrochemistry.—Le Blanc.—An abstract of a paper read before the Internat. Congress for Applied Chemistry, on electrochemical units and symbols for the same.—*L'Eclairage Elec.*, Aug. 18.

Electrodynamometer.—Kollert.—A long and fully illustrated description of a practical form of a mirror electrodynamometer for technical purposes.—*Elek. Zeit.*, Sept. 20.

Earth Current Recorder.—Illustrated descriptions of the Kelvin earth-current recorder, with automatic short-circuiting switch. The connections are given in diagrams.—Lond. *Elec. Eng.*, Sept. 21.

Switchboard Instruments.—Baxter.—A continuation of his illustrated serial (Digest, Mar. 17). This part deals with integrating wattmeters and ampere-hour meters.—*Amer. Mach.*, Sept. 27.

Telegraphy, Telephony and Signals.

Cable Work.—Barwell.—An illustrated article, giving "an explanation of a common phenomenon noticed in cable work." It has been frequently noticed when a splice between two types of cables was paid out into the sea that peculiar sharp kicks were observable upon the galvanometer used for keeping a constant test upon the cable during the operation; and these kicks have been sometimes so marked that they have not unfrequently given rise to the suspicion that an incipient fault had developed in the cable, with the result that paying out has been temporarily suspended until further tests could be taken. He offers the explanation that this phenomenon is due to small changes in the capacity of the cable, caused by variations in the resistance of the contact between the respective sheathing wires at a splice, these variations being due to the application of different strains or pressures, and that the effect is more noticeable when one of the cables has each of its sheathing wires covered by a partially insulating tape. He describes several instructive experiments to prove his explanation. In an editorial note it is said that the cause of the phenomenon has been realized by cable engineers in recent years, and that, as a proof of this, it is the usual practice now when making a spice on board ship between two types of cables, to remove all taping from the outer sheathing wires and to scrape and clean them thoroughly at intervals; and good contact between them is further insured by binding the parts so cleaned together with iron wire wrappings; if this is effectually and carefully done, the phenomenon under notice is usually conspicuous by its absence. The present author also describes a method how to hear a splice with a telephone when the ship is approaching it picking up, provided there is no other disturbing influence at work, such as a variable fault in the circuit; and knowing the depth of water, and noting the first indications of the splice being disturbed on the telephone, one may form a fairly approximate estimate of its distance from the ship.—Lond. *Elec.*, Sept. 21.

Protection of Telegraph and Telephone Wires in Connection with Overhead Traction.—Woodfield.—An illustrated article on overhead construction, with special reference to guard wires. He suggests the following points: Guard wires should be erected 3 ft. to 4 ft. above the trolley wire; they should be vertically over the trolley wire; where used in one continuous length, say, over a quarter of a mile, there is no necessity to earth directly to the rails, provided the wire is in no way insulated from the bracket arm; where used in short lengths, say, to protect two or three spans of trolley wire, it should be directly earthed to the rails; it should not be used around curves where "pull-off" wires are necessary for the guard wire, guard strip being far more suitable; great care should be exercised in anchoring, it being preferable to anchor three or four spans further ahead, where there is any likelihood of the trolley jumping; strong and durable material should be used, and great care be exercised in erection and examination; the bracket hanger clamp should not serve the double purpose of supporting the guard wire standard and the bracket hanger.—Lond. *Elec. Rev.*, Sept. 21.

References.

Type Printing Telegraph.—Conradt.—An illustrated article, in which he shows how the efficiency of the Hughes apparatus can be improved by modifying the arrangement of the keys.—*Elek. Zeit.*, Sept. 13.

Wireless Telegraphy.—Derome.—A continuation of the illustrated article on progress in wireless telegraphy, describing improvements made by Blondel, Tissot and Tommasi, which were mentioned before in the Digest.—*La Nature*, Sept. 22.

Recording Telephone.—An illustrated description of an improved form of Kumberg's recording telephone, noticed in the Digest Aug. 4.—Lond. *Elec.*, Sept. 21.

New Book.

PROJECT FÜR DAS ELEKTRICITAETS-WERK DER STADT WARSCHAU. Erlaeuterungsbericht Nebst Anlagen von W. H. Lindley. Verlag von August Osterrieth, Frankfurt-am-Main, 1899. 72 pages of text, with appendix of 60 pages, containing estimates, tables, schedules, etc., and 20 illustrations, including folded plans, maps, colored diagrams, etc., and a supplement of 24 pages on polyphase system.

This book is a detailed report by W. H. Lindley, engineer, of Frankfort-on-the-Main, to General Bibikoff, president of the city of Warsaw, Poland, on the establishment of a municipal electric generating plant for that city. The engineering features of this plant have already been reviewed in a series of four articles published in the ELECTRICAL WORLD AND ENGINEER some time ago. These articles, constituting a digest prepared with material culled from the report itself, showed that the engineering work done by Mr. Lindley, in the design and details of this plant, is of the highest order, and evinces the possession of considerable engineering skill and experience on his part. The abstracts from the report which were reproduced in these articles gave some idea of the thoroughness and comprehensiveness of the whole report, but, to do full justice to the report as a technical and literary work, a book review is necessary.

The publication of a technical report made by an expert to a municipality, or to a public concern, which is a rare and almost unheard-of occurrence in America, is quite customary and frequent in Europe. The result is, naturally, that the preparation of expert reports receives much more attention there than it does here, as a rule. Indeed, in some cases, apparently as much work, skill and care are expended in the presentation and elaboration of the report as in the procuring or the preparing of the data, facts and information, which form its basis and object. It may be that the expert apprehends, sometimes with reason, that his report will be the principal criterion of, or the monument to, his knowledge and skill; or it may be that he deems it an opportunity and a factor of higher standing and reputation. At any rate, there seems to be such incentive to stimulate the expert, that, occasionally, the expert report turns out to be literally a work of art.

The book before us shows that the author is an adept in this fine art. While "doctors might disagree" as to the merits of Mr. Lindley's engineering, notably his recommendation of the single-phase, alternating-current system, for a combined lighting and power supply service; yet all connoisseurs and experts in the art of making technical reports will be unanimous in praising the faultless "technique" and the general excellence of his report.

The report, to describe it briefly, is an exhaustive study and analysis of the problem of establishing a municipal electric generating plant for the city of Warsaw.

The book contains seven sub-divisions or chapters. The first chapter contains a discussion and analysis of the general principles involved, and of the requirements to be met, in dealing with the problem. The second chapter treats of the question of location for the central station. The third chapter describes various features of design and detail recommended for the station. The fourth chapter discusses methods and details of electrical feeding and distribution. The fifth chapter discusses the question of providing current for street railway operation. The sixth chapter discusses the separation of the equipment into distinct portions, including those to be equipped for serving present needs and those for future needs. The seventh chapter discusses the question of operation and the prospective expenses and revenues.

These chapters and the tables of data supplementing them, which are contained in the appendix, may be said to constitute a veritable treatise on the entire subject of electric central stations in general, and of the Warsaw station in particular. A great portion of the subject matter is of general interest as giving the author's views and arguments on the comparative advantages of the various systems of electrical distribution, including both direct-current system and all forms of the alternating-current system. The same may be said of the portions treating of types, forms and sizes of engine and dynamo units, and their relative advantages and disadvantages, which portions contain much information of general application and value. The diagrams given in Plan 14 showing for various kinds of engine, including steam turbines, the relation between steam consumption and total yearly output in kilowatt-hours, and also the relation between output and cost per kilowatt-hour, deserve special mention as indicative of the high order of technical skill and the painstaking thoroughness bestowed on the preparation of the report. Special mention should also be made of the general diagram (on Plan 12) of the entire electrical system of generation, control and distribution, as well as of the diagram (on Plan 13) of the feeder system, both of which are remarkable in their way, being printed each in five colors. A novel and very ingenious feature is the method of showing the details of the distribution system, by means of a map and three superposable transparent sheets printed in different colors. The map shows in colors the various lighting districts into which the city is sub-divided. Each color, incidentally, indicates the particular division of the station switchboard at which the current supply for said district is controlled. The map also shows the centre of distribution for each district and the feeders supplying these centres. The three transparent sheets are intended to be placed upon the map, in a definite way, so as to make the corresponding points "register" or coincide properly. The first sheet shows the network of tie-lines for interconnecting the various feeding centres. The second sheet shows the location of the transformers and the network of primary lines supplying them. The third sheet shows the secondary mains and distributing lines. In each case the sheet shows the distinction between the first installment, or the part to be built first, and the rest of the equipment. By this plan the distribution system is, so to speak, resolved into its components or elements; and the main features and details of each can be clearly indicated, without producing a hopelessly complex maze of circuit-lines, such as would result from the attempt to even partially indicate these features all on one sheet. The situation plan (No. 2e) and the designs of the central station (Plans 6, 6a, 7, 8) and the designs of the transformer station (Plan 9) junction stations (Plan 10), are not merely preliminary tentative plans, but complete, definite plans, carefully studied and detailed. The text of the report, and the numerous tables of data, estimates, calculations, in the body of the report or the appendix, all manifest the same comprehensiveness and elaborateness. The report, one might say, forms a fine engineering thesis, which, of itself, should suffice to entitle its author to the degree and title of "electrical engineer."

The author has duly recognized, and deferred to, that cardinal principle, too often ignored or forgotten, that a truly scientific technical report must not merely give conclusions, but must indicate the method by which they were reached, and the materials on which they rest. The latter are the proper vouchers for the former—they are the sole credentials whereby the conclusion can command recognition and respect.

This report, therefore, being a particularly good specimen of its kind, is a good standard of comparison whereby we may note and estimate the difference between the American and the European, more especially the Continental, methods and ways of the engineer and the expert. The character and extent of this difference (one might almost say contrast) are a surprise and a revelation to the uninitiated. Speaking generally (for, of course, there are glorious exceptions), this comparison is quite unfavorable to the American engineer. Let us hasten to add, however, that it is not so much the fault of the engineer as of those who employ him. In both cases the kind and the character, ay, the quality of the engineer's work must, of necessity, follow the law of supply and demand. There may be a *need* but (note the distinction) there is scarcely any *demand* for such comprehensive elaborate engineering reports in this country. That is the simple reason for their scarcity. The environment in which the American engineer is placed, influenced as it is by our characteristic business and political methods, practically controls and limits his methods and his work. When an engineer or an expert is employed by a municipality, in this country, he is, in nine cases out of ten, tied to the apron-strings of a committee or a board of commissioners. These worthies have generally much knowledge of politics, and of business, and in some cases have achieved a certain measure of success in both, just enough, it may be, to remove all diffidence in them about "tackling anything that comes along." Those of them who may happen to be interested in manufacturing business, even in the capacity of stockholder, will have still less hesitancy to do the "tackling." They soon absorb the proverbial "little knowledge" necessary to make them dangerous, and after that it is astonishing to see with what zeal and persistency they proceed to teach the engineer or the expert his business. Not infrequently each one goes so far as to develop his own peculiar system or method of engi-

neering, based, of course, upon his special knowledge of business in general, or of some line of business in particular, like the grocery business, the hardware business, or any other business in which he happens to be "eminent." Sometimes, in their modest desire to show their constituency how much more they know than the expert, they go still further and evolve plans and recommendations of their own. Then, too, there are, occasionally, certain political or other considerations, public or private—it may be even personal—sometimes both numerous and complex, which we can merely mention here, not having the space nor the skill to analyze them. As "auspices" these things sometimes prove portentous to the expert, and turn out to be fraught with important influence on his work, even to the extent of taxing his political acumen or his diplomatic skill, and, incidentally his patience, far more than his technical knowledge or experience. But these features, after all, form only the setting, or the background of the engineer's environment. The real keynote of the situation is the widespread practice in America of considering the engineering end as subsidiary to the business end of a project. In Europe the conditions are practically reversed; the business end is usually inspired and guided by the engineering end. The vital importance of the engineer's work, as the true criterion of the merits and prospects of an enterprise, or as the means of establishing it upon a secure foundation, is, let us admit with regret, much more generally admitted, and especially, recognized, there than here. The consequence is that the European engineer plays a more exalted role than his American confrère, who is too often made to play the part of a gear—or still worse, that of a dash-pot or a buffer—in a more or less complicated political "machine," or in a fine piece of business "mechanism." The European engineer is made the referee, whose decision is final and conclusive, not only on all technical points or engineering questions, but even on many, often on all, business questions and problems related to the case. His report has virtually the character and the force of a judge's decision on all points. The client receives it with a deference which often makes its statements peremptory and its conclusions almost mandatory, so far as their effect on him is concerned. The very confidence reposed in the engineer thus becomes an additional incentive which stimulates him to do his best. He is allowed ample time, and, let us hope, adequate compensation, for the preparation of his report. The report is expected to do credit to both the time and the money which it costs, and especially to do full justice to its subject. We can now understand why the report is voluminous, comprehensive and thorough. All this is quite different from American practice. The American engineer is seldom called in consultation at the earliest stage of the project. Usually his services are not retained until the project has already been under consideration for some time, and in some cases, not until its main outlines and features have been decided upon. It may even happen that the "business" management has already committed itself to a plan, or a policy, and the engineer's advice against it would be too late, even if it were wanted. His judgment and opinion on all matters in which "business" enters, even though based on substantial facts and resting on logical ground are considered of less weight than those of the "business men" for whom his report is prepared. Much stress is laid upon the requirement that the engineer's report should be "short and to the point." This means, simply, as the engineer soon learns, that all technical details and all reasoning too scientific to be understood, and especially to be criticised, by the average business man, may as well be left out of his report. The "abstruseness" of the engineer's report, from the business man's standpoint is, as experience teaches, inversely proportional to the ability of the said business man to understand, digest and assimilate its contents. The engineer soon finds that the particular "brand" of report which is most popular is the so-called "business-like" one, consisting of a few typewritten pages which takes a short cut between the premises and the conclusions, or which gives summarily the conditions, the means, and the results, according to the case, with as brief reference as possible to the reasoning which forms the connecting links between them. There may be flaws in these links, but so long as the chain holds together at all its quality is not apt to be questioned. Let us add that the report generally has to be prepared in a hurry, as the engineer is usually not allowed more than a fraction of the time which ought to be allowed for its preparation. Hence, the engineer must, perforce, deal more in generalities and can go less deeply into details than the European engineer.

There are doubtless few, if any, American electrical engineers of experience who will not recognize something quite familiar in our resumé of the peculiar conditions and circumstances which influence engineering work and react upon it in this country. Even in the most favorable cases the engineer must admit that he still had a few of them to contend with, and he will be obliged to admit that they have, to say the least, scarcely improved the quality of his work. It will be argued, perhaps, that the status of the American electrical engineer has improved in the last ten years. Yes, we are now, fortunately, passing away from the days when scarcely anybody thought of consulting an engineer at all and when almost everybody was his own engineer. The scrap heap and the dealer in second-hand electrical machinery are making a rich harvest among the central stations for lighting and power, which were "put up" ten or twelve years ago by "practical" men. The lesson has proven very expensive, but it has been wholesome and has not been wholly lost, although its full significance is not yet realized. Let us frankly admit, however, that the engineer himself ought to, and must, contribute to the object of elevating his own status. The old adage that "he who deserves success commands it" is one which is very suggestive here and which might profitably be borne in mind by the American engineer. The American architect, as we know, has long since solved the problem of raising, establishing and sustaining his dignity on the highest plane. He has done it by means substantially the same as those which the engineer should and must adopt in order to reach the same goal, namely, by striving to create a taste and to develop the habit for better work. Once the "taste" is acquired by the patron it soon develops the "demand." There are isolated examples which illustrate this, even in electrical engineering. In certain lines of work, notably in the engineering of isolated electric plants, there exists already, at least in certain parts of the country, a demand for engineering which is, comparatively speaking, of the very highest grade. This demand is due, one might say, solely to the fact that certain engineers have made it a practice to do a much higher grade of technical and engineering work in their plans and specifications than was paid for or was appreciated by the client. Indeed, at first, and for some years, this high grade of work was objected to as unnecessary by both the client and the contractor, and it was to some extent derided by many, even in the profession. The few, however, who persisted in forcing the client to accept something better than he wanted, have begun to harvest the fruits of their efforts as pioneers and champions of high-grade work. They find that both the quantity and quality of their clientele have improved. Incidentally they have the gratification of knowing that they have done something for the advancement of their profession by contributing their share to the task of familiarizing the American public with high-class electrical engineering work, and by thus helping to bring about a demand for it.

If every American engineer were to acquire forthwith the desirable habit of doing his work a little more thoroughly and even a little more elaborately than he has been doing it, he would still fall considerably short of the European engineer in these respects. He would, nevertheless, be doing something thereby toward helping to raise his profession to a higher plane of merit and dignity, and to secure for it more consideration and better recognition. It would not take long before the public acquired the "taste" and developed the "demand" for the highest class of engineering ability and technical skill.

The Use of the Telephone for Train Dispatching and Other Railroad Business.

The telephone is slowly but surely displacing the telegraph for short-distance train dispatching and other local railroad business. The extent to which this has taken place on some roads will be a surprise to any one who has not followed the matter closely.

The most extensive use of the telephone in steam railroad service is probably made by the New York, New Haven & Hartford Railroad, of which F. P. Valentine is superintendent of telegraphs. This road uses the telephone for all its train dispatching at the Boston terminal and also for announcing the approach of trains from one signal tower to another along the route. It also has leased a long-distance line from Boston to New York, and over this transacts much business formerly done by telegraph. The switch and signal tower at the main terminal in Boston is connected with all the outlying towers on various branches and incoming trains are announced to the main tower from the outlying towers so that signals and switches can be set for incoming trains. An amount of business can be handled this way by telephone which would be impossible with the slower telegraph without several operators. An advantage of the telephone which is appre-

ciated by railroad men is that the switch and signal interlocking towers can be manned by practical railroad men familiar with switching who are not operators. Formerly it was necessary to draw all tower men from the ranks of operators, but this is no longer necessary or desirable, as nothing but the telephone is used in the towers. The signal towers along the road are all connected by telephone, so that the passage of a train is announced from tower to tower by telephone. The long-distance line is in almost constant use for the transaction of general railroad business between cities. Much time can be saved over the telegraph in many cases, for it is often necessary to send a number of messages back and forth to straighten out some tangle, in

OMAHA BRIDGE AND TERMINAL RAILWAY COMPANY.

SPECIAL ORDER.

Form 44.

Governing movement of Trains Nos._____of_____1900.

ORDER No._____

To_____ Council Bluffs,_____1900.

At_____

Train No._____will run_____late from NORTH JUNCTION (Council Bluffs) to UNION PACIFIC JUNCTION.

Train No._____will run_____late from UNION PACIFIC JUNCTION to ILLINOIS CENTRAL STATION (Council Bluffs).

W. B. ORMOND, Chief Dispatcher.

_____ Condr. or Engr. Order No._____O. K._____M.

_____ Operator. _____ Dispatcher.

FIG. I.—FORM 44.

which cases the telegraph would take as many hours as the telephone does minutes.

The officers of the New York, New Haven & Hartford are enthusiasts over the advantages of the telephone for railroad work, and could not be induced to go back to the old system. In fact, there are many places where it would be impossible to carry on the traffic as it is now without radical changes, were the telephone to be thrown out. It is interesting to note that the road that has been most progressive about the adoption of electric motive power is also the one to first realize the applicability of the telephone to railroad requirements.

The Illinois Central in the West is among the progressive roads in regard to the use of the telephone. It has been the practice of this road for some time to transmit orders governing the movement of trains at its switch yards and terminals by telephone. The most important use of the telephone in train dispatching made by this com-

OMAHA BRIDGE AND TERMINAL RAILWAY COMPANY.

SPECIAL ORDER.

Form 3.

Governing movement of Trains 3 and 10 of _____1900.

ORDER No._____

To_____ Council Bluffs,_____1900.

At_____

Train No. 3 will run_____late from ILLINOIS CENTRAL STATION (Council Bluffs) to UNION PACIFIC JUNCTION.

Train No. 10 will run_____late from UNION PACIFIC JUNCTION to NORTH JUNCTION (Council Bluffs).

W. B. ORMOND, Chief Dispatcher.

_____ Condr. or Engr. Order No._____O. K._____M.

_____ Operator. _____ Dispatcher.

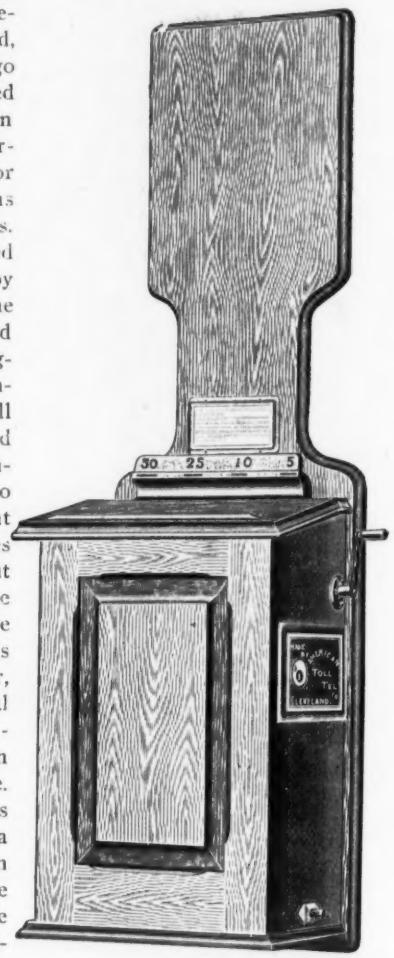
FIG 2.—FORM 3.

pany is that at Omaha and Council Bluffs. The Illinois Central enters Omaha over the Omaha Bridge and Terminal Railway. All trains between Council Bluffs and Omaha are dispatched by telephone orders. To facilitate the receiving of orders the company uses a system of blanks similar to those used with the telegraph system. There are a number of blanks, and each form of blank applies to the movement of some particular trains, except one form which is applicable to any train. Two forms of blanks are reproduced herewith. Form 44 is a blank form applicable to any train. Form 3 is applicable to trains 3 and 10 only. The dispatcher in filling an order fills out the proper blank, and when the order is transmitted the sender first announces the number of the form. The man receiving the message reaches over to a cabinet beside the telephone instrument and procures the proper number of blank. He is then ready to take down the order by filling out the blank places in the form.

Mr. C. F. Annett, assistant superintendent of telegraph of the Illinois Central, through whose courtesy the forms used are reproduced here, is a firm believer in the efficiency and rapidity of the telephone for short distance dispatching like this, and believes the telephone to be in practice more reliable and less liable to derangement than the telegraph. Of course, Mr. Annett presupposes the use of some form of transmitter suited to railroad use and not too responsive to disturbances and noises such as passing trains. In some locations where telephones are not leased from the local telephone companies and the railroad has its own instruments, an instrument made by the Standard Telephone & Electric Company, of Madison, Wis., having a solid back transmitter with wood diaphragm is used. One of the advantages noted with the telephone is that the dispatcher can tell whether the proper man is answering the telephone and receiving the message. The dispatching system from Council Bluffs to Omaha is proving so satisfactory that it will be extended to South Omaha also in the near future.

"Nickel-in-the-Slot" Telephone Long-Distance Pay Station.

The American Toll Telephone Company, of Cleveland, which a few months ago brought out an improved "nickel-in-the-slot" pay station for telephones, is now preparing to furnish a toll box for coins of larger denominations for long-distance toll stations. The box, which is illustrated herewith, has been adopted by the United States Telephone Company, and will be installed in a large number of its long-distance pay stations throughout the State of Ohio. As will be seen, the fixtures furnished by the company include the entire board with battery box, to which the telephone instrument is attached. The box measures 10 ins. by 6 ins. by 16 ins., about half of which is occupied by the toll device. In this device there are but two varieties of signals for the operators to remember, a deep gong and a clear musical bell. One tap on the bell indicates that a nickel has been dropped, and two taps, a dime. One tap on the gong indicates a 25-cent piece, and two taps a 50-cent piece. The slots in which the coins are placed are curved, so that it is impossible to withdraw the coins by attaching a string or wire after the signals have been given.



"NICKEL-IN-THE-SLOT" TELEPHONE PAY STATION.

To secure the signal the person desiring the connection turns a lever at the side of the box. After the coin has been placed in the slot and the lever started, it is impossible to return the lever to the original position until the coin has dropped. Coins smaller than those demanded simply slip through the machine without giving a signal, while steel slugs are drawn to one side and ejected by means of a powerful magnet. The coin receptacle is secured by a Yale paracentric lock, each box having a different kind of key. The cabinet work is of the best and made to match the finish of the instrument. The device will be furnished for desk set if desired. The company asserts that after months of experimenting, a method is yet to be found of "beating" the device out of its due receipts.

Improvements in Telephone Toll Line Switchboards.

Believing that long distance development in the independent field has reached the point where there is a demand for toll boards built to the highest standard of specifications and on the principle that the cost of the board is a consideration entirely second to the quality, the North Electric Company, of Cleveland, Ohio, has recently brought out the toll line board of which we show illustrations, front and back; also some of the parts. It is equipped for ten toll lines with necessary cord equipment, clearing-out drops, and with a full set of triple jacks. The boards are built in units so that they can be mounted side by side, making a continuous switchboard, using anywhere from 10 to 30 drops per operator. The switchboard is complete in every respect, with pigeon-holes and all conveniences for getting at all the working parts which are liable to get out of order in the actual use of the board.

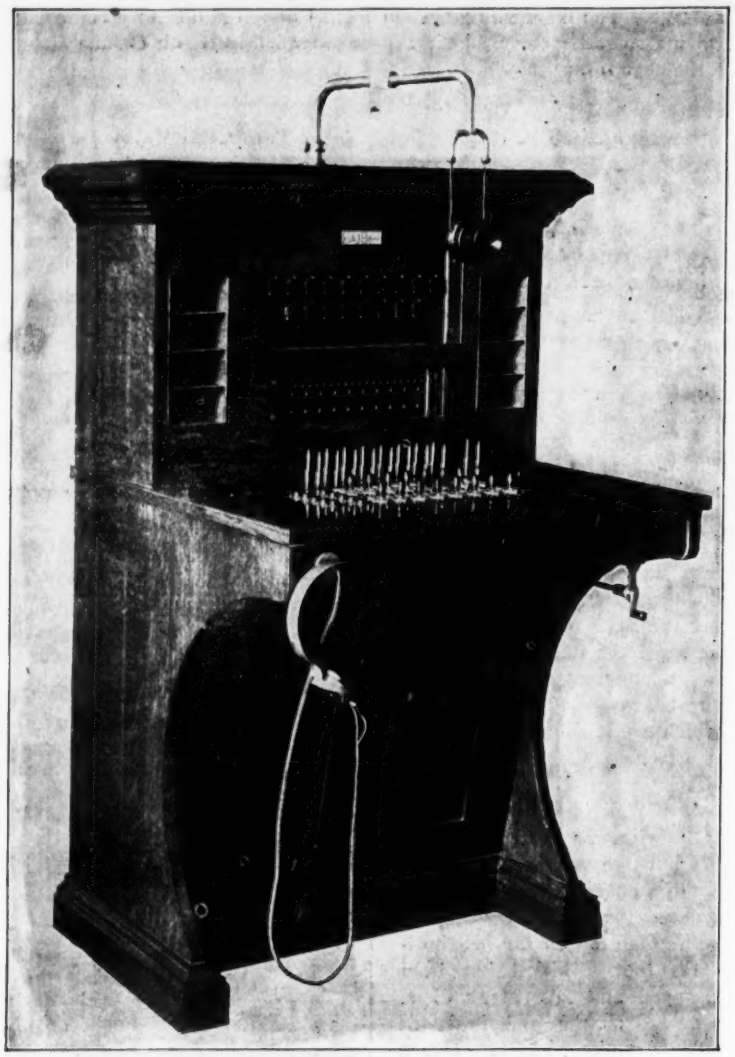


FIG. 1.—TOLL BOARD, FRONT VIEW.

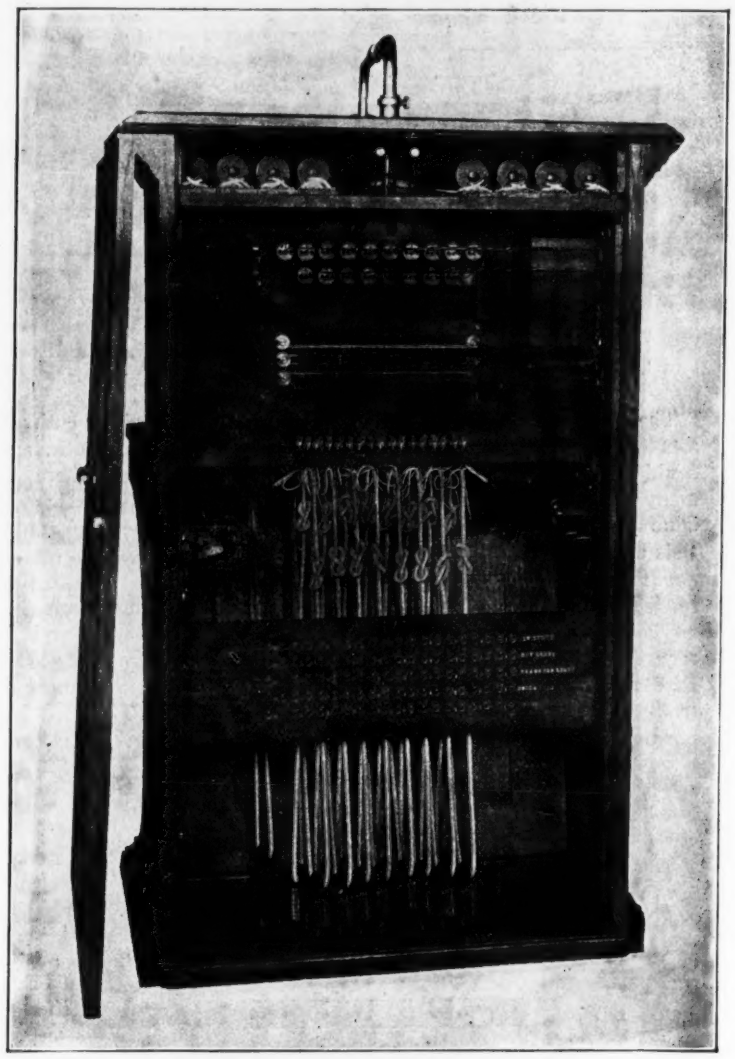


FIG. 2.—TOLL BOARD, REAR VIEW.

The rear view shows the left door removed from the board and standing alongside it. The view also shows the arrangement of the repeating coils in the rack in the upper part of the board, the tubular line and clearing-out board, the cord terminals, guide wires, weights, hand generator, night bell and terminal board, to which is brought all the inside wiring of the switchboard, so that in installing one of these boards it is not necessary for the inside wiring of the switchboard to be disturbed in any way, all the boards being thoroughly and completely tested out before leaving the factory.

This terminal board has all the lines designated in their proper classification and numbered to correspond with the line drops, operator's trunk wires, transfer wires, etc. The keyboard is equipped with double ringing and listening keys so that repeating coils can be cut in or out of the circuit, as desired, if, on making connections it is found advisable or necessary to use them owing to the noise created by the connection of the lines which thus become unbalanced. The operator also has the ability to ring either way on the lines or listen in without in any way disturbing the relations of the circuits over which the parties are talking. The board is equipped fully with transfer jacks and order wires to the different operators of the city board, and with a triple jack which makes it possible to use the two legs of the toll line at the same time, thus giving the best quota of service out of any line passing through the switchboard. The line and clearing-out drop used in this board are of great efficiency, having very high impedance, and being absolutely free from all danger of cross-talk. Every drop is thoroughly inspected and tested both before being mounted in the switchboard and after. The repeating coils, which are ironclad and made of the best material, are perfectly balanced, and when thrown on the line do not disturb the equilibrium of the line, but tend to maintain it. The best of Swedish iron is used in the shell of both the tubular drop and the repeating coils. The jacks, including transfer, answering and triple, are full platinum pointed, absolutely pure platinum being used for this work. They are mounted in rubber, with mica insulation between the springs, the whole mounted on an aluminum base, making a very efficient, and, at the same time, a light and rigid jack. The plug is of the most accepted pattern, well calculated to stand heavy service with the minimum of opportunities for trouble. The highest grades of cords obtainable are used on this switchboard.

A feature not usually furnished on toll boards is the adjustable transmitter support, adjustable both vertically and horizontally, as well as the pivotted headband receiver, which cuts out the transmitter battery on the plug being removed from the operator's jack in the board. This does away with all unnecessary drain on the transmitter batteries when the operator's position is not occupied. This switchboard is put up in the best cabinet with a high-grade finish, all parts being well nickeled or oxidized. Not an ounce of fibre is used on this switchboard, with the exception of the handles for the plugs, it being used there preferably to rubber because of its greater strength.

In no place on this switchboard is there anything used for insulation except the highest grade of mica and rubber.

The North Electric Company claims that it is impossible for any manufacturer to turn out a higher grade of switchboard than this at

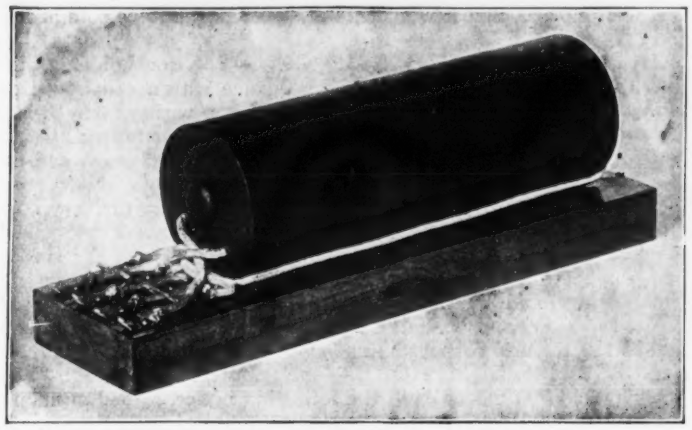


FIG. 3.—REPEATING COIL.

the present state of the telephone art, and it invites an exhaustive test and comparison. It is probably the highest-priced toll board on the market, and its appearance on the scene would therefore indicate a

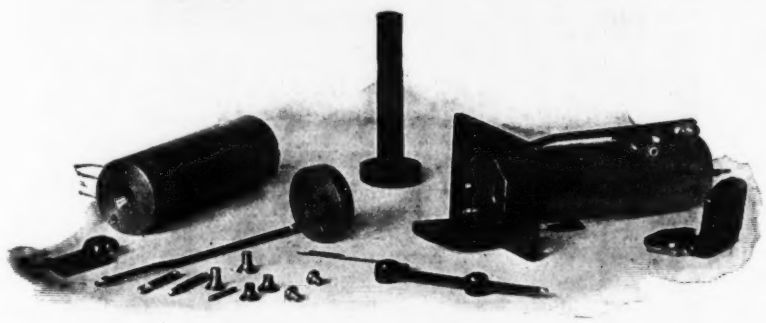


FIG 4.—TUBULAR DROP AND PARTS.

healthy revulsion of feeling in regard to the cheap material with which the telephone field has been flooded, and shows decided confidence in the prosperity of the industry.

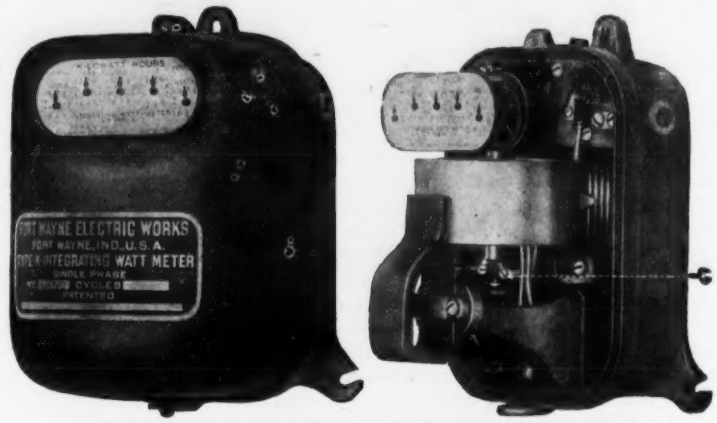
A New Induction Integrating Wattmeter.

The extensive use of the induction wattmeter to register the energy of alternating current circuits has created a demand for meters that will render an accurate record of the true energy of the circuit regardless of the power factor; that has a permanent and reliable calibration, is convenient to handle, install and repair, and covers the broad range of adaptability needed in meter service. The meter illustrated in the accompanying cuts, recently developed by the Fort Wayne Electric Works, is attracting considerable attention, and is said to meet the above requirements. It is of a compact, smooth and well-rounded design, absolutely dust, insect and moisture proof. The rotating parts consist of a light aluminum cup supported on a carefully designed sapphire jewel spring bearing and guided at the top by a loose pin support. The force exerted by the shunt and series coils on the aluminum cup or armature is at right angles to the plane of the shaft, thus preventing any destructive effect on the jewel bearing by the action of the magnetic field. The rotating parts of the meter can be easily taken out by removing the top bearing and the bracket supporting the registering mechanism, making access easy to the entire construction of the meter.

The meter is provided with a device for overcoming the static friction. It consists of a small starting coil wound upon a laminated iron core and placed within the main shunt coil inside the armature. This small starting coil is provided with a screw adjustment by means of which it may be given an angular movement relative to the main shunt coil so that a very fine adjustment is possible.

It is claimed the accuracy of this meter on 1 per cent of load is not affected by the variation of 25 per cent in the voltage; or, in other words, a 100-volt meter will retain accurate calibration on any voltage from 75 to 125 volts. This result certainly marks a distinct advance in meter design, and it is said to have been impossible to accomplish this result by any other method at present employed in overcoming the static friction of a meter.

A very important feature is an arrangement for adjusting the

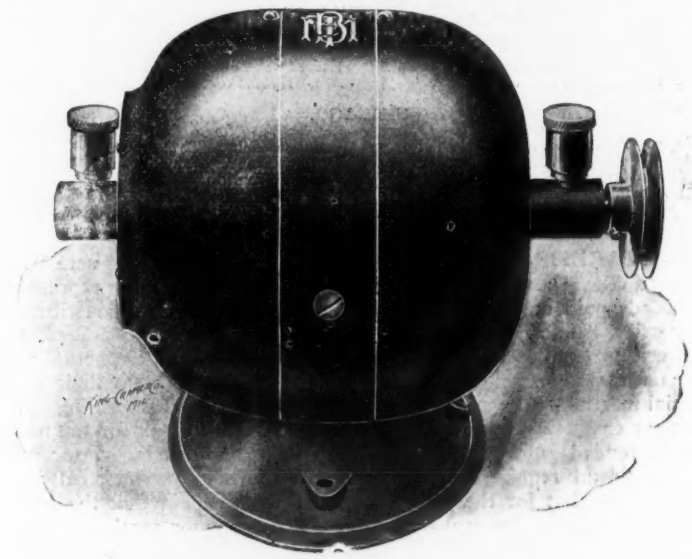


FIGS. 1 AND 2.—INDUCTION INTEGRATING WATTMETER.

meter for any frequency. This is quickly accomplished by the soldering or unsoldering of one joint, and correcting the speed of the meter by the use of the permanent magnet. The dial is of porcelain and is dull finished, giving it the advantage of clearness and eliminating the reflection of light, which often is responsible for inaccurate readings being taken. No constants are used, and the amount of energy registered is read directly from the counter. The torque is high, which insures that the meter will remain in calibration for an exceedingly long time. The weight is less than 13 pounds, and the meter can be installed in a space 6¾ ins. x 8¾ ins.

The Browning Motors.

The production of a motor of very small capacity is a very different task from that of manufacturing or designing large motors and generators. The small motor calls for a specialist in small motors. The Browning Manufacturing Company, of Milwaukee, has for some time made a specialty of motors of from 1-12 to 1 horse-power, for dental engines, jewelers' lathes and all classes of small work. These motors are distinguished by a high grade of workmanship (which is essential to an efficient small motor), and by a handsome finish and compact



1-12-HP MOTOR.

symmetrical appearance. A motor rated at 1-12 horse-power is shown herewith. It is a type very popular for dental use, and for such use is sometimes enclosed in a spherical, nickel-plated case, so that there is no suggestion of an electric motor about the appearance of the outfit. This motor is wound for either 110 or 6 volts, weighs 11½ lbs. and is 6 ins. high by 5¼ ins. wide, with shaft length 7⅝ ins. It is an extremely neat little motor, as well as one thoroughly sound mechanically and electrically.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 2½ per cent, nominal. Time money was held firmly throughout the week, and the demand was fair. The rates were 4½ per cent for 60 days to four months, and 5 per cent for five to six months. There was a fair trade in mercantile paper, the closing rates being 5 per cent for indorsed bills receivable, 5½@5¾ for first-class single names and 6 for others not so well known. In the stock market there was much better feeling and increased activity, with advances in prices on expectations of a settlement of the coal strike and a better feeling as to the political situation. The industrials shared in the gains of the railroad list, also the electrics. Brooklyn Rapid Transit was subject to bear attacks during the week, but in spite of the vicissitudes through which this stock passed it closed with a net gain of 1¾ points. Early in the week it was reported that the Pennsylvania Railroad was negotiating for the control of the company, but this was promptly and positively denied by the Pennsylvania officials. The sales of Brooklyn Rapid Transit for the week aggregated 110,515 shares. There were 1402 shares of General Electric sold at prices ranging from 135½ to 137½, closing at the higher figure, which is 2⅜ points higher than the close of the week previous. Metropolitan Street Railway was quiet at prices ranging between 147½ and 152. It closed with a net gain of 3⅜ points. Western Union was also quiet at almost unchanged quotations, the fluctuations keeping within narrow limits. The market for outside securities showed much strength, the closing quotations in many instances being as much as 2 and even 3 points higher than those of the previous week. Except in few cases the advances were unaccompanied by any considerable activity, the list of electrics being quiet. The following are the closing quotations in the four cities named:

NEW YORK.

	Sept. 29.	Oct. 6.		Sept. 29.	Oct. 6.
Gen. Elec.	134⅞	137½	Elec. Veh.	17	18
Bklyn. Rap. Tran.	50¼	52½	Elec. Veh, pfd.	*50	*50
Met. St. Ry.	*147⅞	151	Gen Car.	4⅝	5⅛
Am. Tel. & C.	—	89	Ill. Elec. Veh. Tran.	1⅛	1
West. Un. Tel.	78⅞	79¼	N. Y. Elec. Veh. Tran.	6½	6¾
Am. Dist. Tel.	—	25½	N. E. Elec. Veh. Tr.	3	3
Com. Cable.	—	160	Tel., Tel & Co. of Am.	5½	5½
Elec. Boat.	14	13	Hud. Riv. Tel.	116	116
Elec. Boat, pfd.	22	24	N. Y. & N. J. Tel.	160	160

BOSTON.

	Sept. 29.	Oct. 6.		Sept. 29.	Oct. 6.
New Eng. Tel.	—	—	Erie Tel.	—	95¼
Mex. Tel.	—	—	Gen. Elec., pfd.	—	139
Westing. Elec.	—	46	Am. Tel. & Tel.	137	139
Westing. Elec., pfd.	—	61	Ed. Elec. Lt.	—	—

PHILADELPHIA.

	Sept. 29.	Oct. 6.		Sept. 29.	Oct. 6.
Elec. Stor. Bat.	57	60	Phil. Elec.	2¼	2⅝
Elec. Stor. Bat., pfd.	61	60	Pa. Elec. Veh.	—	2½
Elec. Co. of Am.	8½	9⅛	Pa. Elec. Veh., pfd.	—	*2
Gen. Elec. Auto.	¼	¼	Am. Rys.	27½	28¾

CHICAGO.

	Sept. 29.	Oct. 6.		Sept. 29.	Oct. 6.
Chicago Edison.	135	135	Chicago Telep. Co.	200	200
Chic. City Ry.	242	242	Union Traction.	10¾	11
Nat'l Carbon.	16	16	Union Traction, pfd.	46½	49½
Nat'l Carbon, pfd.	79	79	Northwest Elev. Com.	—	21

*Asked.

MASSACHUSETTS ELECTRIC COMPANIES.—The net earnings of the Massachusetts Electric Companies, which represent dividends paid on the parent company's holdings in its constituent properties, it is estimated will aggregate for the year ended Sept. 30 between $975,000 and $1,000,000. This estimate is based on actual returns for 11½ months. At the time the companies held their last special meeting, July 30, it was then stated that the gross earnings for the year ended Sept. 30 would reach $5,000,000, although for the nine months ended June 30 they amounted to but $3,102,000. Four per cent dividend requirements on $12,000,000 preferred stock call for $480,000, so that for the year just ended it is evident that the companies will show 4 per cent on the $12,000,000 common stock. A large stockholder says: "When the stock of the Massachusetts Electric Companies was placed on the market two shares of preferred and one share of common were sold for $210. At 74 for the preferred and 22 for the common, the present quotations, the block which originally sold for $210 is worth but $170. This is a ridiculously low price and not warranted by intrinsic conditions." The Railroad Commissioners notified the counsel of the Lynn & Boston Street Railway Company and C. S. Cummings & Co. that the board would refuse to authorize the issue of $1,500,000 additional capital stock until it had made inquiries as to the value of the road, its financial condition and its management. The board further stated that in case the additional issue was allowed, that it would not allow the same to be sold at less than $125 per share.

AIR POWER COMPANIES MERGED.—The stockholders of the American Air Power Company, in accordance with a call issued on Aug. 30 by President D. C. Moorehead, met last week at 621 Broadway and decided to dissolve the corporation. This action was only a legal formality before the corporation could change its name and become amalgamated with the Compressed Air Company of New York. The latter controls the American Air Power Company of New York and the Compressed Air Motor Company of Illinois. The amalgamated company manufactures and controls the patents of the Hardie compressed air motor cars, some of which are in operation on the Twenty-eighth and Twenty-ninth Street crosstown line. Other styles are used in Rome, N. Y., and Chicago. Henry D. Cook was elected president of the new corporation.

TELEGRAPH-TELEPHONE.—The Postal Telegraph-Cable Company has sent us copies of the following notice, signed on its behalf by William H. Baker as vice-president and general manager, and issued last week: "Persistent rumors are in circulation regarding a pending combination of the Postal Telegraph-Cable Company, Commercial Cable Company, Western Union Telegraph Company and American Bell Telephone Company with the Telephone, Telegraph & Cable Company of America. The officers of the Postal Telegraph-Cable Company and of the Commercial Cable Company deny emphatically that either company is contemplating any such combination, and state that the control of the Postal Telegraph-Cable Company and of the Commercial Cable Company is not for sale."

CONSOLIDATION IN LANCASTER.—The Lancaster (Pa.) Gas Light Company and the Edison Electric Light Company, of the same city, on Oct. 9 passed into the control of a syndicate, the members of which are, as yet, unknown. The capital stock of the gas company is $325,000 and the capital stock of the electric light company the same, making a total of $650,000. The stockholders will receive for their gas stock at $60 per share $390,000, and for the electric light stock at $10 per share $65,000, or a total of $455,000. The gas stock paid a dividend of 6 per cent. Since 1895 the Edison Company has not paid any dividend. The new purchasers take the two plants subject to a mortgage indebtedness of $600,000.

WESTINGHOUSE AIR BRAKE.—At the annual meeting of the Westinghouse Air Brake Company it was stated by Mr. Westinghouse that the income for the fiscal year was $8,539,905 and the net profit $3,519,198. The following point is of interest: "The electromagnetic braking and heating apparatus covered by the patents referred to has been tested thoroughly and arrangements have been made to begin its manufacture for which there should be a large demand because of the greater safety to the public and also because the comfortable heating of cars is obtained without using current from the power circuits."

BROOKLYN RAPID TRANSIT BONDS.—The Brooklyn Rapid Transit Company is considering a plan for a readjustment of bonds to gain the advantage of the premium on some of the issues. The profit to the company should the plan succeed, it is stated, would be in the neighborhood of $300,000. The company owns about $9,000,000 of bonds issued by the various companies in the system. The securities are partly held in the treasury of the company.

BOSTON "L" EARNINGS.—The gross earnings of the Boston Elevated Railway for ten months of the fiscal year, ended with July, amounted to nearly $8,500,000.

DIVIDEND.—The Boston Electric Light Company has declared a quarterly dividend of 2 per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—The general tone of trade throughout the country, as indicated by reports to the mercantile agencies, was a favorable one, and the confidence expressed as to the outlook of business for the balance of the year is remarkable in view of the unsettled conditions and the apprehension which usually accompany a presidential campaign. The industrial outlook has been improved by the signing of the tin-plate scale, but the coal situation is apparently not so favorable as it appeared a week ago. A greater number of miners are idle and the production is steadily diminishing. In the iron and steel trade there is an evident indisposition to enter into heavy future contracts, and in this line there is a tendency toward weakness in the cruder forms of production. Pig iron is weak everywhere, being lower at the South and Pittsburg, and the demand is generally for small lots. Reports from Chicago indicate that business in iron and steel is being held back pending election. The market for staples is generally favorable. Altogether the state of trade in all sections has a

satisfactory aspect, notwithstanding the political incubus. *Bradstreet's* reports the number of business failures for the week as 177, as against 169 the previous week, and 146 for the same week last year. In copper, the conditions prevailing week before last are practically unchanged, while prices have receded a shade. Lake Superior ingot is quoted 16⅝c. to 16⅞c.; electrolytic and casting, 16⅝c. In this connection it may be noted that the exports of copper during September were the lowest of any month this year, being 10,362 tons. In the New York machinery market the situation is very quiet, the demand being below the average.

THE BRASS ASSOCIATION.—Nearly all the prominent brass manufacturing concerns in the United States, representing several million of dollars, withdrew Oct. 1 from the American Brass Manufacturers' Association, a co-operative combine organized in the early 90's among the brass workers for mutual aid and protection. The members of the old association were the Plume & Atwood Manufacturing Company, the Benedict & Burnham Manufacturing Company, the Scoville Manufacturing Company, Holmes, Booth & Haydens, and the Waterbury Brass, all of Waterbury, and the Ansonia Brass & Copper Co., of Ansonia; the Coe Brass Company, of Torrington; the Bridgeport Brass Company, of Bridgeport; the New Jersey Steel Tube Company, of Newark, N. J.; the Bristol Brass Clock Company, of Bristol; the Birmingham Brass Company, of Birmingham; the Chicago Brass Company, of Chicago; the Detroit Copper & Brass Company, of Detroit; Manhattan Brass Company, of New York; Rome Brass Company, of Rome, N. Y.; H. K. & F. S. Benson, of Newark, N. J. Since the American Brass Company was formed some time ago interest in the old organization has flagged. This new company was formed by the consolidation of the great concerns of the Naugatuck Valley. The concerns were conservatively represented at $10,000,000 in the pool. Their consolidation so dwarfed the influence of the Brass Association, and their personality so predominated the brass market that there was little hope for the original association, hence the natural dissolution of the old organization, the American Brass Manufacturers' Association. The effect on prices will be watched with interest.

EXCHANGE TELEGRAPH COMPANY.—With an authorized capital of $5,000,000, in 50,000 shares of $100 each, the Exchange Telegraph Company filed certificates of incorporation last week in the office of the County Clerk of Hudson County, N. J., and with the Secretary of State of New Jersey, in Trenton. Great mystery surrounds the ultimate objects of the concern, so far as this city is concerned, but it is understood that it is intended to compete with existing corporations. Its charter authorizes it to acquire by purchase or lease, and to operate throughout the United States, a system of telegraph and telephone wires, to conduct the business of transmitting messages by telegraph and telephone, and transmit and sell market and all kinds of news, to operate tickers and like instruments for the prompt transmission of all market quotations and other news; also to lease to other companies wires and to conduct in the cities and villages of the United States a general messenger service; also to manufacture and sell electrical power and do a general telegraph and telephone business. The incorporators, whose names are unknown here, and who are supposed to be employees of the real backers, are Louis B. Dailey, Clifford Perkins, Evan J. Dudley, Charles H. Barkley, Kenneth K. McLaren, Forrest F. Gould, Millard W. Baldwin, Thornton Parker, John I. Billings and Adolphus Smedburg, Jr., all of New Jersey. James B. Vredenburgh, the attorney for the new corporation, who has an office in this city, declined to give the names of the capitalists interested, but said that the company had ample resources and expected to do an extensive business.

ELECTRIC RAILWAYS IN GREAT BRITAIN.—There is much activity in England in electric railway matters, and accounts of many enterprises of this character have been published in these columns in the recent past. Among the notable undertakings now in hand and in contemplation may be mentioned the following: The Nottingham Corporation is changing its horse car system to electric. About $3,000,000 will be expended in this improvement. Some of the more important contracts have been let. Mr. Arthur Brown is the city engineer. The city of Cardiff will take possession of the tramways in that city on Jan. 1 next. The system will be greatly enlarged and improved. Much of the equipment is yet to be purchased. Mr. Arthur Ellis is the city's electrical engineer. The Maidstone town council will apply for powers to construct an electric railway. The proposed line will be four miles long, and will cost about $200,000. An electric railway is soon to be built at Bournemouth, for which the municipality will borrow $1,000,000. The district councils of Folkestone and Huddersfield are seeking authorization to build electric roads in their respective cities. Other electric traction enterprises are being projected for Paisley, to cost about $1,000,000; for Torquay, costing $250,000, and for Crewe, Herne Bay and Kilmarnock.

AMERICAN BICYCLE COMPANY.—With regard to the future of this "trust," now that the profits of the bicycle industry are no longer as large as they were, one of the leading directors says: "The automobile must be developed in the same manner as the bicycle. I have such faith in the successful development of the automobile that I predict that inside of ten years there will be more automobiles in use in the large cities of the United States than there are now horses in these cities. The demand at present is enormous and we are unable with our facilities and capital to supply the demand of our 30,000 agents throughout the country; 15,000 agents are fairly howling for automobiles. We will direct our attention to the automobile costing the purchaser less than $1,000, as that is the popular price. The automobile of to-day does not meet my ideal as yet, but next year we will certainly have a machine near perfection. You will then find my stable now holding nine horses transformed to store automobiles, and my horses will be sold." The outstanding capital of the company is as follows: $10,000,000 5 per cent sinking fund gold debenture bonds; $10,000,000 7 per cent cumulative preferred stock and $20,000,000 common stock. The shares are selling at $5 for the common and $27 to $30 for the preferred.

BELL TELEPHONE PRESIDENCY.—Directors of the American Telephone & Telegraph and American Bell Telephone Companies have elected Alexander Cochrane president pro tem, succeeding John E. Hudson, deceased. Mr. Cochrane is a director and member of the executive committee of both companies. The vacancy in the directorates, caused by the death of Mr. Hudson, was not filled. A stockholder says: "The two largest stock interests in the American Telephone & Telegraph Company have no representation on the board of directors, namely, the Crane and Vail interests. Gov. Murray Crane would make an excellent officer of the corporation, while none better can be found than Theo. N. Vail. Mr. Vail was for many years general manager, and laid the foundation for operating the great system. His relations with the Commercial Cable & Postal Telegraph Company would enlist the co-operation of the Mackay-Bennett interests and tend to harmonize and bring together more speedily the telegraph and telephone. Mr. Vail is now in Europe, and will probably spend the winter in South America unless he can be induced to consider the taking of an active part in the Bell management."

NEW ENGLAND ELECTRIC VEHICLE.—The New England Electric Vehicle Transportation Company has had a very prosperous summer considering the small number of vehicles in operation. Its Newport season was especially satisfactory. It had 75 open vehicles in operation in Newport leased by the month and the demand exceeded the supply. It has 100 cabs in operation in Boston and 50 delivery wagons, and will probably not add to this equipment this winter. It has equipped its main station in Boston with apparatus for automatically charging the vehicles, which will effect a considerable saving in operating expenses. The plant has been described in the ELECTRICAL WORLD AND ENGINEER. The company is doing away with pneumatic tires and replacing same with solid tires. It is found that the solid tires are far more economical. A solid tire with run 4000 miles, whereas the life of a pneumatic tire is but 2000 to 2500 miles, and they are in constant need of repair.

POWER PROJECT IN CALIFORNIA.—The Fort Miller Power Company, which is composed of California capitalists, is about ready to begin the construction of an immense flume and power house 22 miles northeast of Fresno and two miles from the town of Pollasky. The project, according to its promoters, has for its purpose the leading out from the upper reaches of the San Joaquin River of an enormous body of water, which will be carried by a wooden aqueduct for more than 10 miles and given a fall of 800 feet. After driving the electric generators the water will be turned back into the channel of the stream. It is estimated that 45,000 horse-power will be available. The board of directors of the new company consists of Walton Saunders and Fulton G. Berry, of Fresno; Thomas O. Carter, M. F. Saunders and Alfred J. Morganstern. The last named is making preparations to visit London, where he will endeavor to interest capitalists in the matter.

THE AMERICAN BRIDGE COMPANY has commenced making very large shipments on account of the steel work for the subway in New York City. Already about 2000 tons have been shipped, and the material is now being sent in at the rate of about 100 tons per day. The total contract comprises about 80,000 tons of structural material, and is being manufactured at the Keystone plant of the company.

ARC LAMP CONTRACTS.—The contract has been awarded the Western Electric Company, Chicago, by the Denver City Construction Company, for 1000 open constant current arc lamps and 200 constant current enclosed arc lamps. The same company has also been awarded the local contract for 84 constant current series enclosed arcs for the Diversey Boulevard, Chicago.

ELECTRIC POWER IN INDIA.—Tenders have recently been asked from selected firms for equipping an extensive electric power supply plant in the Mysore gold mining district. Current is to be generated at the Canvery Falls and conveyed 100 miles to the gold mines. The Mysore Government is to defray the cost of the installation.

SCIENTIFIC APPARATUS.—The returns show that during the eight months elapsed of 1900, the value of the scientific apparatus shipped from this country was $4,171,561, as compared with only $1,762,855 in the same period of 1896. There is a good deal of electrical material in the category.

General News.

THE TELEPHONE.

COLUMBUS, OHIO.—The United States Telephone Company is putting up six lines between this place and Delaware.

RIDGEVILLE, IND.—The Ridgeville Telephone Company proposes to extend its lines into the country in this vicinity.

CORSICANA, TEX.—F. B. McElroy, of Rockport, Tex., is arranging for the construction of a telephone system in Corsicana.

DAYTON, OHIO.—The City Council has refused to grant the application made by the Progress Telephone Company for a franchise to build a toll line through the city.

FINDLAY, OHIO.—The new Findlay Home Telephone Company has secured permanent headquarters in the Corwin Building. The exchange apparatus is to be installed at once.

ATLANTA, GA.—The Central of Georgia Telephone Company has been incorporated, with capital stock of $200,000, by T. C. Parker, O. H. Weaver, E. Y. Mallory and J. J. Cobb.

JONESVILLE, LA.—The Growt Telephone & Telegraph Line, L. J. Growt, proprietor, will be extended about 100 miles; 150 instruments will be installed and other improvements made.

COLUMBUS, OHIO.—The merchants of this city have subscribed $1,000 toward building a direct telephone line from here to Nashville, in Brown County. The line is to be completed in 30 days.

HAMILTON, OHIO.—The West Butler County Telephone Company has been granted a franchise in certain portions of this city. The number of telephones is limited to 25, subject to location and operation of the city board.

CLEVELAND, OHIO.—The United States Telephone Company is at work on a long distance line from Massillon to Columbus taking in the exchanges at New Philadelphia, Urichsville, Newcomerstown, Zanesville and Newark.

SPRINGFIELD, ILL.—The Adams County Telephone Company contemplates the extension of its lines from Fowler to Quincy. There is an opening in this section for a farmers' line between Golden, Camp Point and Clayton.

WARSAW, IND.—The Commercial Telephone Company, of Warsaw, has been incorporated. Capital, $30,000. Incorporators: J. A. Widaman, O. Oldfather, C. M. Burket, S. W. Chipman, C. E. Wahl, M. R. Williams, all of Warsaw.

SUSQUEHANNA, PA.—The Susquehanna Telephone & Telegraph Company has been incorporated, with a capital stock of $5,000. The incorporators are: M. H. Eisman, F. Zellar, M. Millane, E. R. Barrett and J. F. Lannon, all of Susquehanna.

PITTSBURG, PA.—After a discussion with the Borough Council of Irwin, Pa., which has lasted for several weeks the Federal Telephone Company has at last come to an agreement with the authorities, and a new telephone line is now being erected in that place.

WILMINGTON, DEL.—The New York, Philadelphia & Norfolk Telegraph Company has been incorporated here to do a telegraph, telephone and message business. Capital, $150,000. Incorporators: A. Higgins, H. Emmons and D. J. Reinhart, Wilmington, Del.

THE POSTAL TELEGRAPH IN PHILADELPHIA.—The Postal Telegraph-Cable Company has just transferred its main office in Philadelphia to the handsome seven-story building at the corner of Chestnut and Juniper Streets. The new plant is complete in every respect.

CLEVELAND, OHIO.—The Exchange Construction Company, this city, is at work on independent exchanges for local companies at Canal Dover, Dennison, Urichsville, New Philadelphia and Newcomerstown. Mr. C. D. Judenal, of this city, was the promoter of the new companies.

CIRCLEVILLE, OHIO.—The Citizens' Telephone Company, of this place, has effected a permanent organization and elected officers as follows: President, C. C. Chappelear; vice-president, Irvin F. Snyder; secretary, Dr. Holman; treasurer, Clarence Curtain. The company has signed 160 contracts, and work of construction will start at once.

LOS ANGELES, CALIF.—After repeated protests it is said that the Sunset Telephone Company is about to bring suit against the Los Angeles Electric Company to compel the latter organization to reduce the voltage carried over its wires, which is now 3000. There has been much complaint against the telephone service, and the Sunset Company has laid the blame on the Los Angeles Company, claiming the heavy voltage caused induction. An injunction and damages will be asked for.

BELL TELEPHONE OUTPUT.—The American Telephone instrument statement for the month ended Sept. 20 shows:

	1900.	1899.	1898.	1897.
Gross output	44,190	56,698	31,977	19,198
Returned	30,942	20,073	12,931	7,105
Net output	13,248	36,625	19,046	12,093
Since Dec. 20—				
Gross output	501,354	488,737	244,724	162,743
Returned	220,903	145,227	108,259	69,109
Net output	280,451	343,510	136,465	93,637
Total outstanding	1,860,956	1,468,760	1,055,586	867,468

ELECTRIC LIGHT AND POWER.

CAPE MAY, N. J.—A new electric lighting plant is to be erected here by former Senator L. E. Miller.

KINGSTON, N. C.—This town has repurchased the electric light plant, and the system will be extended to the new portions of the town.

CHARLOTTE, N. C.—A 500-light plant will be erected at the Avalon Cotton Mills, Mayodan, N. C., by the Southern Electric Company, of Charlotte.

KENTON, OHIO.—The City Council has closed a five-years' contract with the Kenton Electric Light Company for 120 arc lights, at an annual price of $75 each.

LAKE CITY, N. J.—The Lake City Electric Company, Lake City, has been incorporated. Capital, $20,000. Incorporators: J. J. Coady, J. B. Smith, I. R. Army, A. Carskadden, M. E. Hutchison, all of Lake City.

SPRINGFIELD, OHIO.—The city clerk has been authorized by the Council to advertise for the furnishing of not less than 260 2000-cp arc lights for lighting the city streets. Bids are to be received for terms of three, five and ten years.

MARYSVILLE, OHIO.—The electric light plant at Richwood, near this place, owned by Edward Schambs, of Mansfield, was burned to the ground a few days ago, entailing a loss of about $17,000. The plant was insured for $8,000.

RADFORD, VA.—Contracts have been let, amounting to $20,000, for the developing of a water-power and the erection of a power house at Radford, Va., by the Electric Light & Power Company. George W. Mills is president of the company.

PHILADELPHIA, PA.—A director of the Philadelphia Electric Company states that the company's receipts in August increased 16 per cent over August, 1899, and that the rate of increase since Jan. 1 has ranged from 15 per cent to 20 per cent.

LIMA, OHIO.—The Lima Electric Railway & Light Company has made a proposition to the city to furnish not less than 171 arc lamps at $89 each for a term of 10 years. The former price was $90 per lamp, and the city will probably demand further concessions.

MANITOWOC, WIS.—The Committee on electric light appointed to confer with John Schuette, president of the Manitowoc Electric Light Company, has recommended that the proper officers of the city be authorized to negotiate with Mr. Schuette for the purchase of the electric light plant by the city.

WELDON, N. C.—The Roanoke Navigation & Water Power Company has awarded the contract to Morton Reid & Company, of Baltimore, for the construction of the big electric light plant on the canal of the company here. The company will furnish lights for Weldon and Roanoke Rapids and power for several mills.

SAN FRANCISCO, CALIF.—The Truckee River General Electric Company's transmission plant near Floriston, Calif., is completed, and after a thorough inspection it will be placed in operation. Leon M. Hall, consulting engineer for the Comstock Pumping Association, will report upon the work. When everything is found to be in accordance with the articles of agreement, the remaining $25,000 of the $100,000 bonus will be paid. The amount of the bonus is to be rebated to the various mining companies in the association as they pay for power used. It is likely that the Gould & Curry Mining Company's works will be the first to receive electric power.

FOSTORIA, OHIO.—The City Heat & Light Company recently made such a radical increase in rates for incandescent lamps that residents are up in arms. In retaliation the City Council is taking steps to put the company to a great expense by enforcing its ordinance. It seems that the ordinance which was acquired from the Fostoria Light & Power Company specified that all arc lamps should be of a type made by a Fort Wayne company. When the plant was installed it was found that this clause shut out competition, so it was not enforced and other lamps were purchased. Now the Council proposes to enforce this clause. C. E. Palmer, a prominent business man, has announced that he will erect a new plant if the city will grant a franchise.

THE ELECTRIC RAILWAY.

LAFAYETTE, IND.—An electric railway is projected to run between this city and Veedersburg.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company has declared a dividend of 1 per cent, payable Oct. 5.

WABASH, IND.—Fred C. Boyd has secured the rights necessary for an interurban electric line between this city and Peru.

SOUTH BEND, IND.—Messrs. Randall & Beers, of Fort Wayne, are negotiating with the Indiana Railway Company for an extension of their railway from Goshen to Wawasee Lake.

MANSFIELD, OHIO.—Cars were placed in operation on Sept. 29 on the new Shelby-Mansfield Electric Railway. The portion of the road from Mansfield to Rocky Run will be operated for the present.

PITTSBURG, PA.—The Monongahela Traction Company, of this city, has ordered 23 new cars for the winter, which will be placed in operation between Pittsburg and Wilkinsburg, East Pittsburg, Braddock and Turtle Creek.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Traction Company has signed a contract for the construction of its electric road. Its cost is estimated at nearly a million dollars. The power house will be at Mooresville.

AKRON, OHIO.—The Portage Lakes Traction Company has applied to the County Commissioners for a 50-year franchise. The Commissioners demand that several changes be made in the conditions, and they are not willing to grant more than a 25-year franchise.

PITTSBURG, PA.—The Keystone Car Wheel Company has started its new factory at Hays Station, six miles from this city. It employs 100 men, and has a capacity of 330 wheels per day. The company was organized last June. Mr. Charles V. Slocum is president.

FIRE IN BROOKLYN POWER HOUSE.—A fire occurred in the power house of the Brooklyn Heights Railroad Company, at Second Street and Third Avenue, on Oct. 3, causing damage to property and apparatus to the extent of about $10,000, and an hour's tie-up.

PITTSBURG, PA.—The Consolidated Traction Company is making a number of improvements on its many lines for the winter. It has purchased 15 new cars, and it is now rapidly laying the tracks on the Forbes Street extension, which will give a shorter and more direct route between Pittsburg and Braddock.

THE AUTOMOBILE.

MR. C. G. WRIDGWAY, engineer of the DeDion-Bouton Motorette Company, of Brooklyn, N. Y., has just been awarded at the Chicago Inter-Ocean Automobile Show a special championship gold medal for his run of 1600 miles with a motorette on a trip from New York to Chicago in record time and without any accident. This wonderful record for one of these motorettes is certainly a remarkable proof and demonstration of the practicability and utility, as well as the good working qualities and reliability of this machine.

LEGAL.

JUDGE TRUAX has granted an order dissolving the Schmidt & Bruckner Electric Company, of 135 Elm Street, New York, and appointed Lambert Schmidt permanent receiver. Mr. Schmidt was appointed temporary receiver on June 5 in a suit brought by Frederick C. Bruckner against Lambert Schmidt for a dissolution of the copartnership.

OBITUARY.

JONES.—We regret very much to note the recent death, in New York City, of the wife of Mr. Francis W. Jones, electrical engineer of the Postal Telegraph-Cable Company.

GEORGE T. THOMPSON.—The death of Mr. George Treadway Thompson occurred in Denver on Oct. 1. He was president of the Denver Consolidated Gas & Electric Company and had held the office since the organization in 1899. Mr. Thompson was obliged to make his home in Denver because of lung trouble, but he took up his work with ability and was greatly successful. His home had been in St. Louis, where he was born in 1869. The climate of Colorado did not prove as beneficial to him as had been hoped, and two months ago he was unable to continue his duties. He was taken to a sanatarium in Denver, and there he died. His associates were greatly attached to him for his admirable personal traits and respected him for his unusual ability in the conduct of the affairs of the company. The remains were taken to St. Louis for burial.

PERSONAL.

MR. SAMUEL C. PLATT, Eastern manager for the Kellogg Switchboard & Supply Company, of Chicago, was a recent visitor at the home office in that city.

MR. A. B. SHEPARD, manager of the Cleveland office of the General Electric Company, was married on Sept. 18, to Miss Gertrude Robbins, of New York City.

MR. ARTHUR WARREN, of the Westinghouse Electric Manufacturing Company, sailed for England last Saturday, after a stay of about a month on this side of the water.

MR. H. L. SHIPPY, of the John A. Roebling's Sons Company, has just returned from a European business trip of two or three months, in good health and spirits and quite cheerful as to the outlook abroad.

PROF. R. B. OWENS, of McGill University, had the misfortune recently to slip while golfing and to break one or two smaller bones of the foot. He is now convalescent, and finds that even on crutches he can carry on his lectures to the electrical classes.

MR. P. G. GOSSLER, electrical engineer of the Royal Electric Company at Montreal, has been visiting old friends in New York the past week. His work in connection with the celebrated Chambly development has been most successful, but even larger work is now ahead.

MR. JOSEPH LEITER and Mr. Joseph H. Hoadley have sailed for London to consult with Charles T. Yerkes in reference to equipping the underground tunnel railway in which Mr. Yerkes is interested. It is understood these gentlemen will advocate the advisability of utilizing compressed air as motive power instead of electricity.

MR. CHARLES P. PLATT, formerly of Chicago, is now general sales agent for the Sun Electric Manufacturing Company, manufacturers of telephones, switchboards and supplies, of Philadelphia, with office at 1205 Girard Building. This is a new company, and one that has done well in securing a man of Mr. Platt's experience in the telephone field.

MR. E. E. SCHWARZKOPF, late of the *Automobile Magazine*, is now to publish *Automobile Topics*, a weekly devoted to the subject in which he is so deeply interested and with which he is so well acquainted. There are many—too many—automobile journals, but Mr. Schwarzkopf ought to be able to make the best, if he tries. His headquarters will be in the Park Row Building, New York City.

PROF. R. OGDEN DOREMUS, who occupies the chair of chemistry in the College of the City of New York, and is one of the oldest electrical experimenters in this country, has just celebrated his fiftieth wedding anniversary. Mrs. Doremus was Miss Estrella E. Skidmore. One of their sons is associated with the Crocker-Wheeler Company; another, Prof. C. H. Doremus, is a well-known member of the American Institute of Electrical Engineers and the New York Electrical Society.

MR. J. D. DARLING, electro-chemist with Harrison Bros. & Company, Incorporated, of Philadelphia, sailed for Europe on the Teutonic last Wednesday. Mr. Darling has gone abroad in connection with the sale of his electrolytic process for making metallic sodium and nitric acid from nitrate of soda. A full-sized furnace has been shipped to Paris and the process will be shown in operation there. At the works of Harrison Bros. & Company, Incorporated, in Philadelphia, a plant has been in successful operation for some time past.

Trade Notes.

THE AMERICAN ELECTRIC SPECIALTY COMPANY, manufacturing the ohmmeter, has changed its name to F. B. Sage & Bro. They are continuing at 123 Liberty Street, New York City, as before. Their ohmmeter received honorable mention at the Paris Exposition.

THE AMERICAN STONE CONDUIT COMPANY, of Eighteenth and Lincoln Streets, Chicago, has recently received contracts for a large amount of conduit work, some of the largest contracts being from the Illinois Central Railroad and the Cincinnati Edison Electric Company.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, of 831 Arch Street, Philadelphia, has just sent out its regular monthly blotters, which, this month, bear a very pretty country scene, with a calendar for the month of October. This blotter will be sent to any one in the trade upon application.

ROMAN STONE ARCHES.—The Engineering News Publishing Company has just issued "Engineering Studies, Part 2, Roman Stone Arches," by Charles E. Fowler, in paper cover, with some handsome illustrations. It is only 16 pages, but these are very much to the point, the descriptions being brief and pithy.

BUSINESS CHANGE.—Messrs. Huebel & Manger, Brooklyn, N. Y., on Oct. 1, transferred their stock, tools and machinery, fixtures, good will, etc., to the Manhattan Electrical Supply Company, New York. Messrs. Huebel & Manger are now associated with the Manhattan Company as superintendent and general manager of its factory.

THE MAINTENANCE COMPANY, 220 Broadway, New York, in a pamphlet just issued, with the catchy title "16 to 16, the pure gold standard," gives facsimile reproductions of 16 letters testifying to this company's service. At the back a brief history of the business is given. Those having electrical plants would do well to look into the merits of this company's system.

THE WESTERN ELECTRIC COMPANY, Chicago, has just shipped a number of new series enclosed alternating arc lamps, which are to be installed at Birmingham, Ala. These will be operated in series on a 60-cycle alternating circuit direct from the mains. At this frequency the terminal voltage is from 78 volts to 80 volts, so that 26 lamps can be operated on a circuit from 2000 volts to 2080 volts, current 7 amperes.

THE DEDION-BOUTON MOTORETTE COMPANY, of Brooklyn, N. Y., is furnishing its French dry batteries to the trade. This battery operates this company's tricycles, quadricycles and motorettes for 3000 to 3500 miles. A stock is always carried on hand. The Motorette Company is also furnishing a specially prepared lubricating oil for DeDion and other makes of motors, which has been prepared for it after careful experiments.

MR. CHARLES T. JAEGER, late with the American Miniature & Decorative Lamp Company, New York, and formerly with the American Endoscopic Company, Providence, R. I., has entered into business for himself under the name of Jaeger Miniature Lamp Manufacturing Company, with headquarters in Bible House, Eighth Street and Fourth Avenue, New York. The company will manufacture a full line of miniature incandescent electric lamps, including series, surgical, candelabra and telephone signal lamps.

MR. JAMES G. BIDDLE, of 1038 Drexel Building, Philadelphia, recently supplied a cable-testing outfit to the U. S. Signal Corps for the cable ship Burnside, which has just sailed for Manila. The outfit included a Fisher cable-testing set, manufactured by Morris E. Leeds & Company, and a marine galvanometer, manufactured by Elliott Bros. A short time ago Mr. Biddle also supplied apparatus for testing the submarine cables to be installed in Alaskan waters under direction of the Signal Corps. Most of this apparatus was manufactured bv Morris E. Leeds & Co.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, has recently taken the exclusive agency for the Western Telephone Construction Company, of Chicago, for a very large territory. The company is now prepared to build lines and equip exchanges complete from stock, and switchboards can be supplied on short notice. The company states that it has one of the best telephone engineers in the country at the head of its telephone department, who will cheerfully answer any inquiries concerning the installation or operation of telephone lines and exchanges.

PLANING MILL EXHAUSTERS.—The B. F. Sturtevant Company, Boston, Mass., has just issued a second edition of its catalogue No. 101, describing and illustrating the Sturtevant steel plate planing mill exhausters. These exhausters are used for the purpose of removing comparatively light material, such as chips, shavings and sawdust, from woodworking machinery. They are driven by belt or electric motors direct-connected. The catalogue gives considerable information on the subject and many illustrations, together with some engineering tables as aids in calculations for exhaust outfits.

FLEXIBLE MICANITE PLATE.—We have received from the Mica Insulator Company, New York, a sample of flexible micanite plate, style C, which is the latest addition to the line of insulating materials produced by this company. The mica laminations are coated with an insulating varnish, then pressed together, and the whole given another thorough coat of varnish. The plate is very flexible. Professor Sheldon, of Brooklyn, has tested this plate, and his report shows that the average breakdown pressure in volts per mil of thickness was 1500 volts alternating. This was the highest limit out of three samples tested. The lowest was 1140 volts. This new material is manufactured in sheets 36 in. x 36 in. in size and of any thickness from .01 in. upwards. It is stated that it will stand a high temperature without losing its mechanical strength, and that it will remain flexible indefinitely. It is recommended for insulating transformers, armature and field magnet cores, armature slots and commutator shells, and general insulating purposes.

WILLYOUNG X-RAY APPARATUS.—Mr. Elmer G. Willyoung, 82 Fulton Street, New York, has just brought out a 32-page pamphlet describing and illustrating his varied line of X-ray apparatus. The type "H" X-ray machine, which has just been put on the market, has an extra heavy secondary discharge, which, when used with properly designed tubes capable of taking care of them, give

great penetration and exceedingly short exposures. This machine is guaranteed for large volume of discharge as well as sparking length. An important feature of the catalogue outside of the descriptive matter is the discussion of the fundamental principles underlying X-ray coils. Among the specialties manufactured by Mr. Willyoung is the universal D'Arsonval galvanometer, which can be changed instantly from wall to table, and vice versa. It is complete with telescope and scale, or scale and lamp, as preferred. Mr. Willyoung reports that he has just sold a 15-in., type "H," induction coil, together with accessory apparatus, to the Roosevelt Hospital, New York, the selection of this machine having been made after a careful investigation.

BOSTON EDISON EXHIBITION.—The Edison Electric Illuminating Company, of Boston, Mass., on the evening of Oct. 3 opened its new exhibition department in its new building, 1 and 2 Head Place. President Edgar gave a reception to representatives of the press on this occasion. The exhibit, which is free to the public, comprises all of the latest and most improved devices for utilizing the Edison current in the house, store, factory, theatre, church, office and studio for light, heat, power, cooking, ventilating, refrigerating, etc. Prominent among the many striking novelties displayed is an electric refrigerator and ice machine, with a capacity of 2000 lbs. of refrigeration, or 1000 lbs. of ice per day. This is a recently discovered method of electrical application, and is attracting a great deal of attention in the scientific and mechanical world. A forge for heating iron to welding heat by means of electricity, a horse-clipping and grooming machine, a meat chopper and a coffee and spice mill are a few of the interesting mechanical devices shown; while in the sphere of lighting the variety of novel and interesting effects is unlimited, especially in the line of ornamental electric signs.

THE GREGORY ELECTRIC COMPANY, Chicago, reports among recent shipments the following: One 120-kw Westinghouse alternator to Home Electric Light & Power Company, Elkhart, Ind.; one 100-kw T.-H. alternator to Aurora Gas Light & Coke Company, Aurora, Ill.; one 150-kw Westinghouse alternator to Lowell Electric Light Corporation, Lowell, Mass.; one 300-kw Westinghouse alternator to Saginaw Valley Traction Company, Saginaw, Mich.; one 60-kw General Electric alternator to Iron River Electric & Power Company, Iron River, Wis.; two 70-kw T.-H. alternators to J. A. Grant & Company, Boston, Mass.; one 70-kw Westinghouse alternator to Crowley Electric Company, Duluth, Minn.; one 200-kw Crocker-Wheeler generator to San Francisco Gas & Electric Company, San Francisco, Calif.; one 50-kw Wood alternator to Macon Electric Company, Macon, Miss.; one 45-kw Edison motor to Sears, Roebuck & Company, Chicago, besides a very large number of arc dynamos and generators and motors from 40-kw capacity down to the smaller sizes. The company reports that it is now sending out more apparatus than ever before in its history, there being a very heavy demand for its machines.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED OCT. 2, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

658,753. RAIL BOND; G. B. Blanchard, Seattle, Wash. App. filed June 25, 1900. Consists of a single piece of conducting material bent upon itself to form a laminated strip, the strip having two flat end portions or feet and an intermediate arched portion or loop.

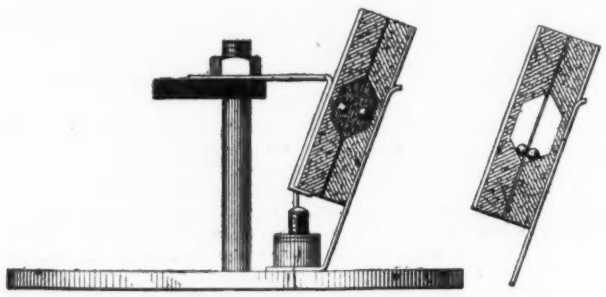
658,792. CIRCUIT MAKING AND BREAKING DEVICE; P. M. Lincoln, Niagara Falls, N. Y. App. filed Oct. 19, 1898. A device for automatically opening and closing an electrical circuit at regular intervals and adaptable for general use.

658,808. MOTOR WHEEL FOR AUTOMOBILES; H. Simmons, Wellston, Ohio. App. filed April 3, 1900. Power is applied to the inner rim of the wheel by frictional contact.

658,814. MEANS FOR DELICATELY SUSPENDING MOVING PARTS; W. Stanley & H. M. Smith, Great Barrington, Mass. App. filed May 1, 1900. A magnetic body which under the influence of magnets is held suspended or in floating position is maintained in proper alignment by a taut steel wire which passes through the centre of the magnetic body.

658,815. METHOD OF PRODUCING PHASE DISPLACEMENT; William Stanley, Great Barrington, Mass. App. filed May 2, 1900. (See page 577.)

658,821. ELECTRIC GENERATOR; L. G. Woolley, Kenton, Ohio. App. filed Dec. 28, 1899. A swinging pendulum, such as an ordinary clock pendulum,



658,976.—Lightning Arrester.

carries a permanent magnet having poles arranged so that the swinging movement will carry them alternately through a solenoid and create a feeble electric current.

658,865. SECONDARY BATTERY; H. C. Porter, Chicago, Ill. App. filed Dec. 27, 1898. Comprises a grid composed of bars having V-shaped grooves in upper and lower sides so that pockets will be formed between the bars. The side pieces have perforations that register with the spaces between the bars of the grid.

658,891. ELECTRODE AND ELECTRODE CONNECTION; H. Carmichael, Malden, Mass. App. filed May 11, 1899. Provides against corrosion of electrodes.

658,900. BATTERY FLUID; G. Romanelli, New York, N. Y. App. filed Jan. 13, 1900. Consists of cupric chlorid mixed with sulfate of sodium.

658,905. ELECTRIC CURRENT REGULATOR; D. Watkins, Davenport, Ia. App. filed March 28, 1900. The invention resides in means whereby the current is controlled by a voltmeter or indicator and a rheostat working in conjunction.

658,924. ELECTRICAL FITTING; W. T. Pringle, Lansdowne, Pa. App. filed Feb. 12, 1900. A new article of manufacture consisting of an attachment plug integrally molded of porcelain, ceramic, artificial stone or similar refractory material.

658,925. ELECTRIC SWITCH; N. D. Rand, Watertown, Mass. App. filed Feb. 10, 1900. The contact points are adapted to be grouped in different ways, and a number of switch arms are provided, each having means for completing a different circuit through the contact.

658,929. ELECTRICAL SEMAPHORE SYSTEM; J. Shoecraft, Topeka, Kan., and C. C. Gardiner, Bradford, Kan. App. filed June 20, 1899. Details.

658,967. RAIL BOND; J. T. Stack, Chicago, Ill. App. filed July 13, 1899. Details.

658,976. LIGHTNING ARRESTER; F. B. Cook, Chicago, Ill. App. filed Feb. 7, 1900. The two parts of a circuit maker are normally held out of contact by a mass of non-conducting material. This mass is melted by an abnormal current and the two parts of the circuit maker come together and establish a path for the current to ground.

658,997. ELECTRICAL PROPELLING APPARATUS; D. Perret, Neufchatel, Switzerland. App. filed June 20, 1900. Winding mechanism for clocks in which a double-acting current interrupter is used.

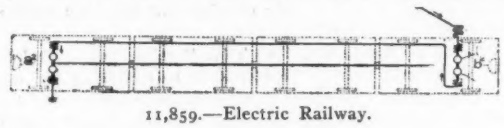
659,061. ELECTRIC LAMP; F. L. Fowler, Philadelphia, Pa. App. filed Oct. 25, 1898. Details relating to the connection between base and globe, the base being detachable.

659,096. COMBINED RELAY AND REPEATER FOR TELEPHONE LINES; Edward C. Paramore, Philadelphia, Pa. App. filed Nov. 18, 1899. (See page 576.)

659,121. APPLIANCE FOR AUTOMOBILES; E. W. Ayers, Washington, D. C. App. filed June 16, 1900. Consists principally of an auxiliary device under control of passengers whereby the vehicle may be stopped at any time necessary.

659,134. SELF-CLOSING VALVE FOR STEAM PIPES; F. W. Churchouse, Tacoma, Wash., and H. O. Benedict, Seattle, Wash. App. filed Jan. 25, 1899. For suddenly stopping steam engines in emergencies. A number of push buttons located at different points about a building, ship or the like, control a common magnetic device which releases a self-closing valve in the steam pipe.

659,142. CROSSING FOR SUSPENDED ELECTRIC CONDUCTORS; J. Floyd, Washington, D. C. App. filed Feb. 2, 1900. Details which provide a crossing for a trolley wheel which runs on top of the conductor wire.



11,859.—Electric Railway.

659,152. OPEN SWITCH DETECTOR; J. M. McCauley, Binghamton, N. Y. App. filed Nov. 16, 1899. The switch tongue acting through certain levers and gearing throws a pivoted tube either into horizontal or tilted position. The tube carries mercury which completes a circuit when the tube is horizontal, but which runs to one end when tube is tilted and breaks the circuit. A signal is located in the circuit.

659,169. MECHANISM FOR SUPPLYING ELECTRIC POWER TO RAILWAY CARS; G. F. Gale, Boston, Mass. App. filed March 21, 1899. The car carries arms which operate an underground circuit making and breaking disk in the manner of a turnstile. The arm on the forward truck rotates the disk and cuts current into a section of the conductor rail, while the arm on the rear truck rotates the disk still farther and cuts current out.

659,178. ELECTRIC RAILWAY SYSTEM; E. C. Morgan, Chicago, Ill. App. filed Jan. 2, 1900. Structural details.

659,179. COMBINED THIRD AND TRACTION RAIL FOR ELECTRIC RAILWAYS; E. C. Morgan, Chicago, Ill. App. filed Jan. 2, 1900. Structural details.

11,859. (Reissue.) ELECTRIC RAILWAY; J. B. Entz, Philadelphia, Pa. App. filed Feb. 14, 1899. Means for operating motor cars from each end of a train which comprise a train-conductor circuit or system, and identical controllers on each motor car provided respectively with devices for arranging the motors and train conductor circuit or system in fixed combination on the rear car, and with devices for cutting out the train-conductor circuit or system and reversing the motors on the front car.

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Panel-Boards

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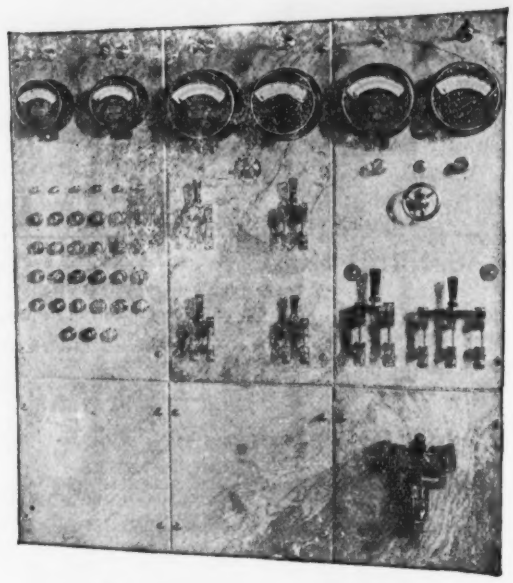

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2⅝ inches deep.
2 inches wide.
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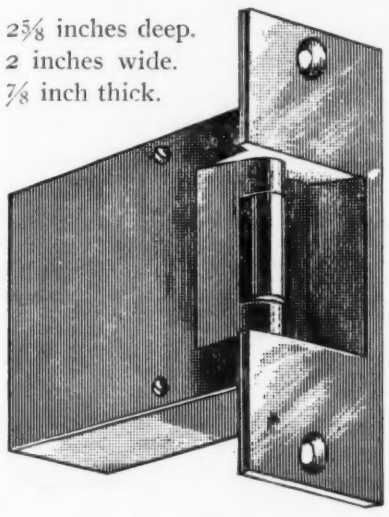

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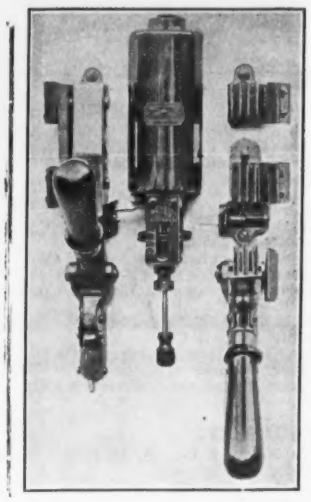

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We allow 50 amperes per square inch of switch contact surface in rating the switches. But because of the perfection of contact in our form of switch, 100 amperes per square inch causes no more heating than 50 amperes per square inch in the switch of the "knife blade" type.

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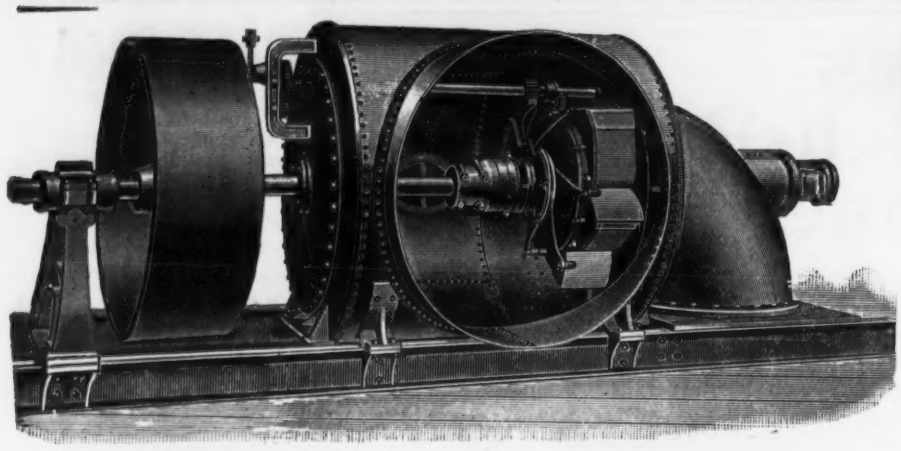

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General Incandescent Arc Light Co.
Guarantee Electric Co.
Kellogg Switchboard & Supply Co.
Keystone Electric Telephone Co.
Kokomo Telephone & Electric Co.
La Roche & Co., F. A.
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North Electric Co.
Northwestern Telephone Mfg. Co.
Phœnix Electric Telephone Co.
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Vulcanized Fibre Co.

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Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
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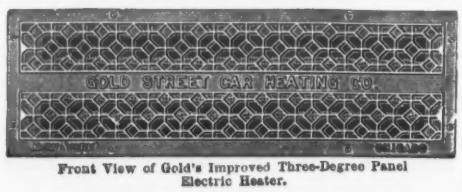

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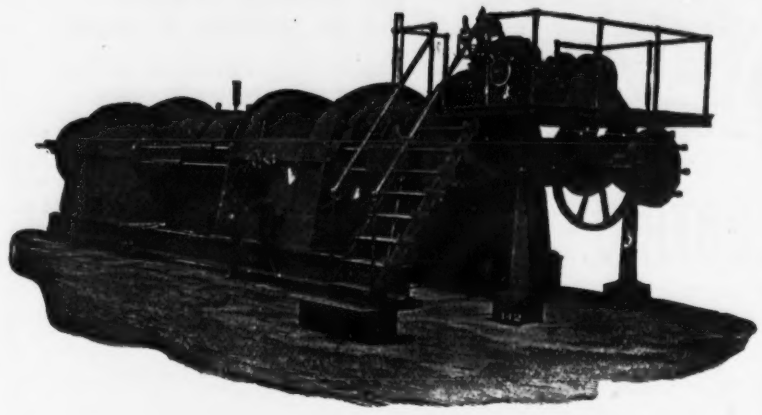

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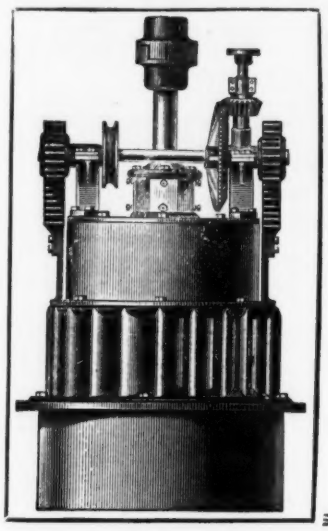

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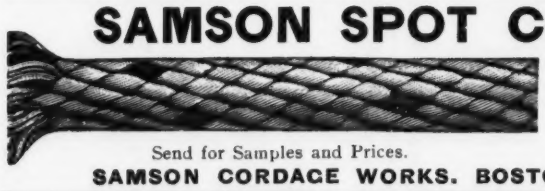

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